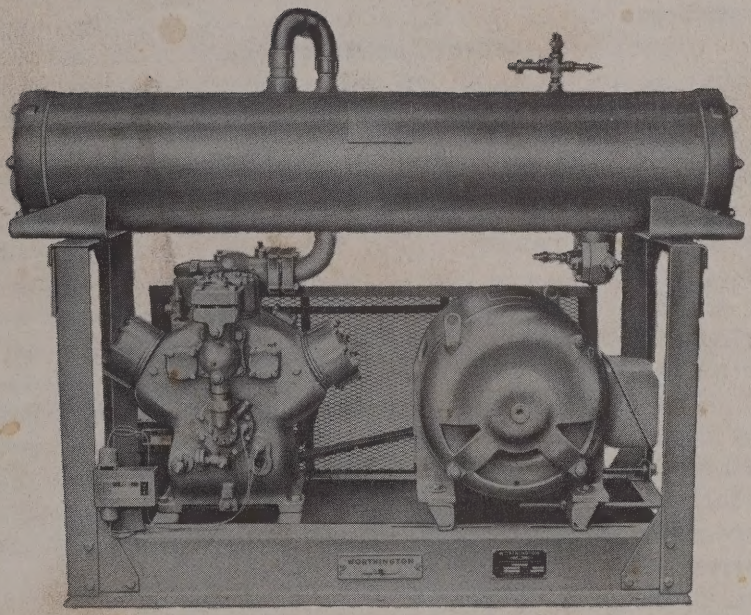
C-1100-E47C
PRICE $ .75

WORTHINGTON

CONDENSING UNITS

MODEL J

3JS4 TO 6JF6



C-4033

INSTRUCTIONS FOR INSTALLATION and OPERATION

WORTHINGTON CORPORATION - AIR CONDITIONING AND REFRIGERATION DIVISION

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"J" COMPRESSOR LIMITATIONS

Max. differential between suction and discharge	200psi
Max. operating discharge pressure	250psig
Max. High Pressure cutout setting	270psig
Max. operating suction pressure	135psig
Min. operating suction pressure	5psia

(Slightly lower may be acceptable if the oil pressure can be maintained at least 20psi above crankcase pressure)

Min. operating suction pressure must not be less than discharge pressure minus 200psi

Compression ratio must not exceed 10.5 for refrigerants 12 or 22. A compression ratio of more than 7 or 8 will probably make a two stage system more economical.

Max. discharge temperature	275 F
Max. temperature of entering gas	75 F
Min. temperature of entering gas	-40 F
Min. superheat of entering gas	15 F
Max. temperature of outside surface of crankcase at bullseye boss	130 F
Max. temperature of oil	140 F
Max. surface temperature at underside of seal housing	135 F
Max. head temperature, both cylinders unloaded	150 F
Min. difference between oil to bearings and crankcase	20psi

Compressor Model	Min. Speed	Max. Speed			Max. HP at Compressor		Max. Torque at Compr. - lb - ft	
		Belt Drive		Direct Drive	Belt Drive	Direct Drive	Belt	Direct Dr.
		R-12	R-22					
3JS4	425	848	848	900	34.5	46.0	193	215
3JF4, 3JF6	784	1167	1167	1200	34.5	46.0	193	215
4JF4, 4JF6	500	950	950	1200	69.0	86.2	493	527
6JF4, 6JF6	500	920	920	900	172.5	230.0	1242	1404

Lower speeds than the minimums shown, may result in inadequate lubrication.

FREON CONDENSING UNITS
REFRIGERANT 12 AND 22

INTRODUCTION

The success of any installation is the result of the combination of proper engineering, correct installation, erection, adjustment and operation. It is very important that oil return to the compressor at the same rate as it leaves. It should return at a reasonably continuous rate and not in a form which might be called "slugs."

No refrigerant in liquid from should return to the compressor. Small quantities of liquid refrigerant, occasionally, may possibly do no damage, and a fine mist of liquid may appear to do no harm for some time, but it will reduce the viscosity of the cylinder lubricant and reduce the life of the liners and rings.

While the following instructions are intended to assist in obtaining proper operation, they are necessarily brief. There are many factors which affect the operation, including the many methods of control. Some systems have variable capacity and varying load, which may result in liquid carryover. The means of obtaining oil return may result in oil or liquid returning in slugs, sufficient to be dangerous to the compressor. In that case an appropriately sized knockout drum, with proper drain, must be installed.

Many systems, particularly those having multiple evaporators which may operate independently, face and bypass dampers or all outside air, may operate at a very low proportion of their capacity. It is important that the compressor capacity is able to balance the load without the evaporating temperature getting too low or the compressor suction pressure falling to the point where the ratio of compression is excessive. Back pressure regulators, balance loaders and other means are available to permit very low capacities.

The means of control of the capacity and the setting of the differential of pressure switches, should be such as to avoid short cycling of a compressor or too frequent changing of the unloaders.

INSPECTION:

Check parts received with shipping lists; report any shortages.

Carefully inspect the condensing unit for any damage done in transit. All damage claims must be made promptly to transportation company, who will inspect the damage and make proper notification on freight or express receipt. The local Worthington Office should also be notified of any claims made.

HANDLING:

Uncrate unit carefully. Skids are provided under the steel frame and should not be removed until unit is moved into position over foundation.

When handling with chain hoist or block and fall, place a rope sling under the frame. Do not attach sling to compressor cylinder block.

Should it be necessary to partially disassemble the unit to facilitate rigging into place, carefully measure all available openings and do not disassemble more than absolutely necessary to permit entry of the equipment.

LOCATION:

Compressor unit should be installed in a clean, light place and in such a manner as to be freely accessible.

Adequate space for servicing must be provided around and over the compressor.

The condensing unit should be accessible from all sides and sufficient space above the compressor provided to remove the cylinder heads and valve assembly.

Condensing unit may be located in enclosed area if sufficient ventilation is provided to dissipate heat radiated by compressor and motor. Suitable openings should be arranged to take advantage of air currents or suitable exhaust fan arranged to insure adequate ventilation.

Shell and tube condensers require that consideration be given for availability of condenser water supply and drain of adequate capacity. Where condensing unit is located so as to be subjected to freezing temperature, proper provision must be made to completely drain condenser and water piping.

Sufficient space must be provided for the refrigerant lines, bearing in mind that suction lines must be accessible for application of insulation.

When condensing unit is operated with shower (evaporative type) condenser, sufficient space must be provided for the discharge line to the condenser in addition to the suction line from the evaporator. The liquid line in this case will run directly from the shower condenser to the evaporator.

FOUNDATION:

The compressor or unit should be set on the foundation or floor and leveled carefully using shims and wedges under the steel base, or under the compressor if there is no steel base. Level the unit in two directions taking care to see that it rests solidly and equally on the foundation.

A satisfactory "rule of thumb" for determining the amount of concrete to use is, "Concrete mass to be twice the weight of the machine." Where necessary, because of soil conditions, extend the below floor foundations 4" to 6" or more beyond the edges of the above floor foundation to properly distribute the load and give added mass. Fig. 1 illustrates this as well as showing the correct method for installing anchor bolts and sleeves.

After unit is level, build a suitable frame around the top of the foundation. Mix two parts of clean, sharp sand and one part of Portland cement, adding enough water to make a mixture that will flow freely. To reduce contraction that occurs while cement is hardening, non shrinking grouting products such as Emprico, are recommended. Wet the foundation top thoroughly and pour grout from all sides, carefully filling all foundation bolt holes.

When grout has hardened sufficiently to be self-supporting, remove the frame and trowel the grout smooth. A slight pitch from the base of the unit to the edge will properly drain the foundation.

After grout is hard, remove the wedges and draw down foundation bolts uniformly.

CAUTION: Do not connect piping to the unit until grout is thoroughly set. Piping must be supported so that no strain is extended on compressor.

PIPING:

Piping must be in accordance with all local codes or regulations.

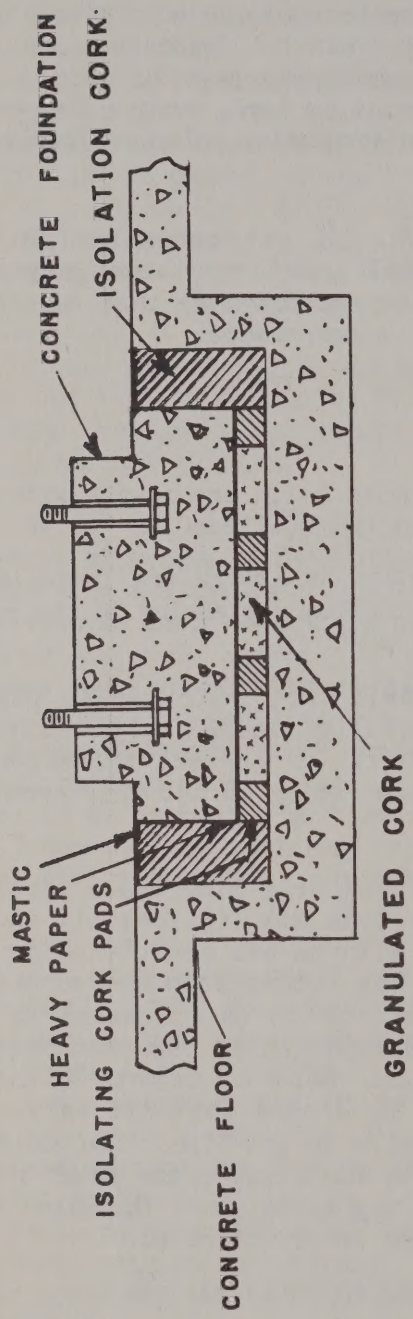
See section in Design and Installation Manual or Price Book pertaining to the refrigerant to be used.

IMPORTANT: All refrigerant piping must be carefully cleaned by blowing out or swabbing out to prevent the entering of any foreign matter in the refrigeration system.

If the discharge line has a vertical rise greater than six (6) feet, it should be equipped with an oil drain trap or oil separator. The return from the separator or drain trap is to be connected to the gas equalizer opening on the crankcase of the compressor. Refer to drawing HX-14687. There shall be a hand shut-off valve and a solenoid valve in the line. The solenoid valve shall be wired across the motor starter in such a way as to close the valve when the compressor is not operating.

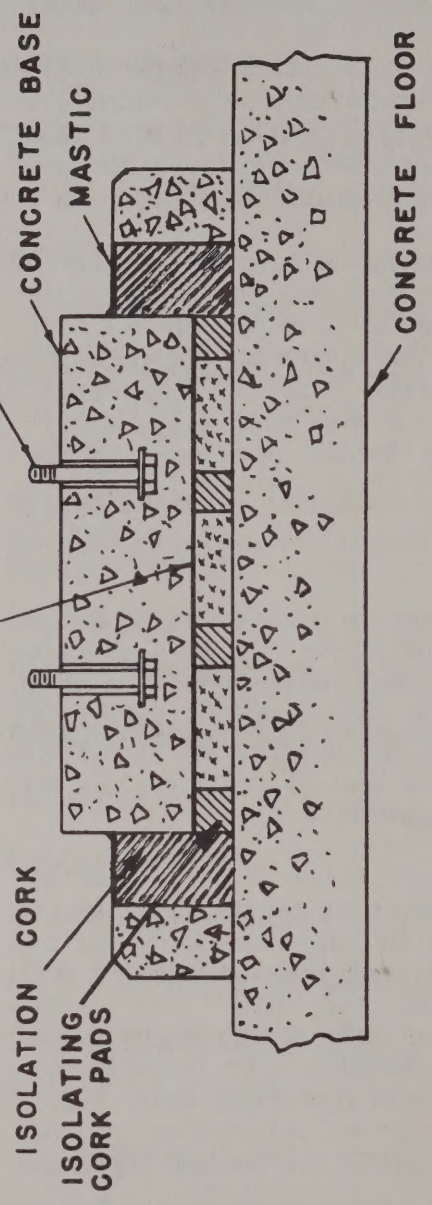
REFRIGERANT PIPING ARRANGEMENT:

The suction line should be very slightly pitched toward the compressor to prevent accumulation of oil and refrigerant in the line. Sufficient room should be left around the suction line for insulation as required.



Typical pit foundation

Fig. 1



Typical surface foundation

Fig. 2

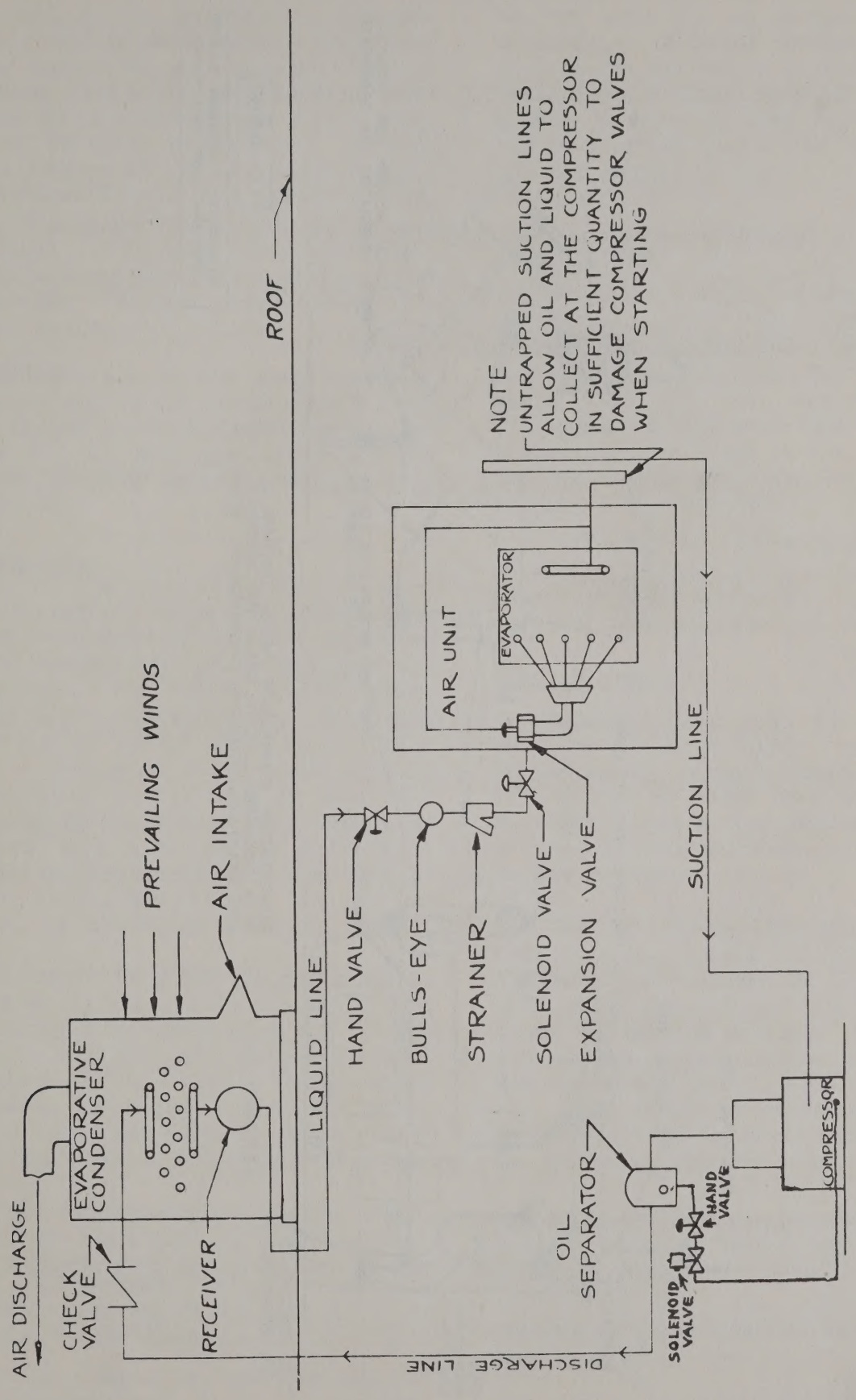
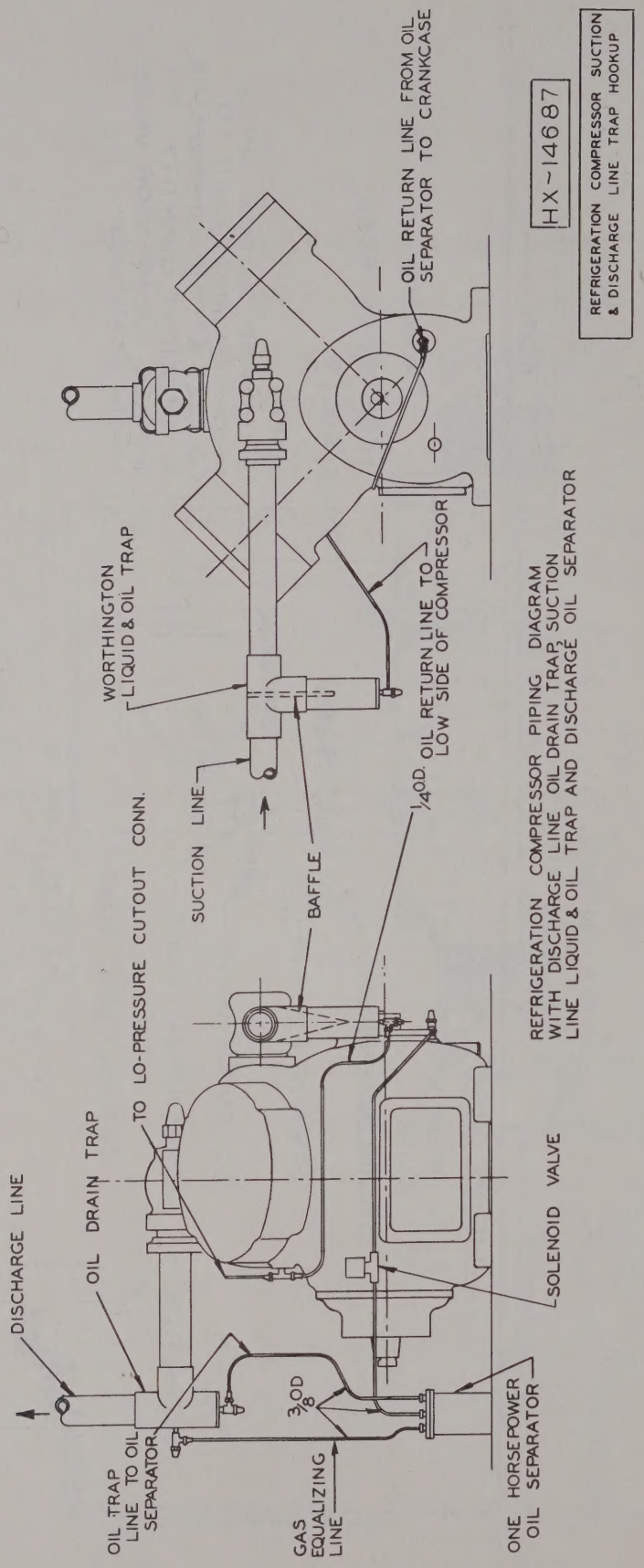

ROOF
PREVAILING WINDS
AIR INTAKE
AIR DISCHARGE
CHECK VALVE
EVAPORATIVE CONDENSER
RECEIVER
LIQUID LINE
HAND VALVE
BULLS-EYE
STRAINER
SOLENOID VALVE
EXPANSION VALVE
AIR UNIT
EVAPORATOR
NOTE
UNTRAPPED SUCTION LINES ALLOW OIL AND LIQUID TO COLLECT AT THE COMPRESSOR IN SUFFICIENT QUANTITY TO DAMAGE COMPRESSOR VALVES WHEN STARTING
SUCTION LINE
OIL SEPARATOR
HAND VALVE
SOLENOID VALVE
COMPRESSOR
DISCHARGE LINE

Fig. 3


DISCHARGE LINE
OIL DRAIN TRAP
TO LO-PRESSURE CUTOUT CONN.
SUCTION LINE
BAFFLE
1/4 O.D. OIL RETURN LINE TO LOW SIDE OF COMPRESSOR
WORTHINGTON LIQUID & OIL TRAP
OIL RETURN LINE FROM OIL SEPARATOR TO CRANKCASE
SOLENOID VALVE
3/8 O.D.
OIL TRAP LINE TO OIL SEPARATOR
GAS EQUALIZING LINE
ONE HORSEPOWER OIL SEPARATOR
REFRIGERATION COMPRESSOR PIPING DIAGRAM WITH DISCHARGE LINE OIL DRAIN TRAP, SUCTION LINE LIQUID & OIL TRAP AND DISCHARGE OIL SEPARATOR
HX-14687
REFRIGERATION COMPRESSOR SUCTION & DISCHARGE LINE TRAP HOOKUP

The liquid line may parallel the suction line, leaving ample room for the suction line insulation as required. The hot gas discharge line should be slightly pitched away from the compressor and when a considerable vertical rise occurs, a trap should be located at the compressor to prevent condensed liquid from flowing back onto the discharge valve when it is not in operation. A suitable trap can be arranged by looping the discharge line from the compressor discharge valve downward to the floor level.

CAUTION: Due to the small quantity of oil continually in circulation in the system, proper provision must be made to insure that oil does not collect in the evaporator, thereby lowering the level in the crankcase.

OIL SEPARATORS:

Worthington's Model "J" condensing units can be equipped with Oil Separators, which are designed to remove oil from the discharge gas, and automatically return entrained oil to the crankcase. Oil laden gas enters a perforated pipe and is forced through a series of filters which thoroughly separate the oil from the gas. Oil accumulates in the bottom of a separator shell, and will open either a float or needle valve (depending upon the type of separator used), and return oil to the crankcase, by discharge pressure.

The return from the separator is to be connected to the gas equalizer opening on the crankcase of the compressor. There should be a hand shut-off valve and a solenoid valve in this line. The solenoid valve should be wired across the motor starter in such a way as to close the valve, when the compressor is not operating.

If the compressor has an oil check valve with multiple vent, no external vent line is required from the crankcase to the suction. Compressors with the multiple vent check valve are coded with a letter "C" stamped on the crankcase bullseye pad.

In those compressors where an external vent line is required, a 1/4" line should be run from the top opening on the seal housing, to a point between the suction gauge valve and the compressor. This line shall have a hand shut-off valve which should be cracked open sufficiently, to maintain proper venting of the crankcase, but not enough to permit oil pumping at start up.

LIQUID LINES:

A solenoid valve should be installed in the main liquid line, and wired across the motor starter in such a way as to close the valve when the compressor is not operating. This will help prevent the liquid from being carried over into the crankcase of the compressor and causing severe slugging and loss of oil from the crankcase, if the expansion valve does not close tight.

If possible, individual liquid line solenoids should be installed for each evaporator, to permit coil surface being reduced, as compressor is unloaded.

SUCTION LINES:

Suction lines must be installed in such a manner as to insure return of oil to the compressor. A new T-shaped suction trap, (see drawing HX-14687) or a drained loop in the suction line at the compressor will help to provide efficient return of oil to compressor crankcase.

The oil return line from the suction trap or loop, should be connected to the compressor as follows: On the 6JF6, 6JF4, 4JF6, 4JF4, and 3JF6 the line should be returned to the low pressure control connection in the suction chamber at the back of the compressor (drive side). On the 3JF4, this line should be connected to the low pressure control connection at the top of the compressor (suction side).

NOTE: For other recommended piping procedures, refer to "Design and Installation" Manual.

EVAPORATORS AND CONDENSING UNIT ON THE SAME LEVEL:

Run both suction and liquid lines to

the ceiling, and then down to the condensing unit, pitching the suction line toward the compressor to facilitate oil return. On close coupled installations, running of both lines up to the ceiling, helps to eliminate vibration strains as well as provide the proper trap at the evaporator.

If during unloaded operation, vertical suction line velocities are too low, a double riser system may be necessary. Double suction risers produce slugs and a drained trap at the compressor may be required. See "Design and Installation Manual"

EVAPORATORS ABOVE CONDENSING UNIT:

When evaporators are installed above compressors, an inverted loop rising to the top of the evaporator coil, should be made in the suction line. This is done to prevent liquid refrigerant from draining into the compressor during shut-down periods. The trapped volume of liquid refrigerant and oil in the cooling coil will be handled successfully when the machine starts.

WATER PIPING:

Piping should be sized for the flow required and pressure drop available. Condenser and water valve losses should be taken into consideration.

DRAIN PIPING:

Water used for condensing refrigerant in the condenser should be conducted to suitable waste line in a pipe of adequate capacity, so as not to impose undue pressure drop and thereby decrease flow of water through the condenser. The water must be carried to an open drain unless it is to be reused.

To facilitate servicing of the condenser, locate a drain valve at the lowest point in the condenser water system and arrange suitable piping to a convenient waste line. This drain connection provides an easy means of draining the system should the unit be subjected to freezing temperatures. This water piping should be in accordance with all local codes and regulations.

WIRING:

Wiring must be in accordance with all local codes and regulations both as to size and method of installation.

Do not connect conduit rigidly to condensing unit. A short piece of flexible conduit should be used

Supply lines to a condensing unit motor, should be taken from a circuit of adequate capacity to maintain full voltage at the motor during starting and operation.

All motors should have a starter or other means of providing overload protection. The overload protection should be carefully checked to see that it matches the motor rating. If it does not, it is useless.

All circuits should have suitable fused or circuit breaker protection, since most starters do not have adequate breaking capacity to provide short circuit protection.

All motors should be connected through a suitable disconnect switch located near the unit.

WIRING HOOK-UP:

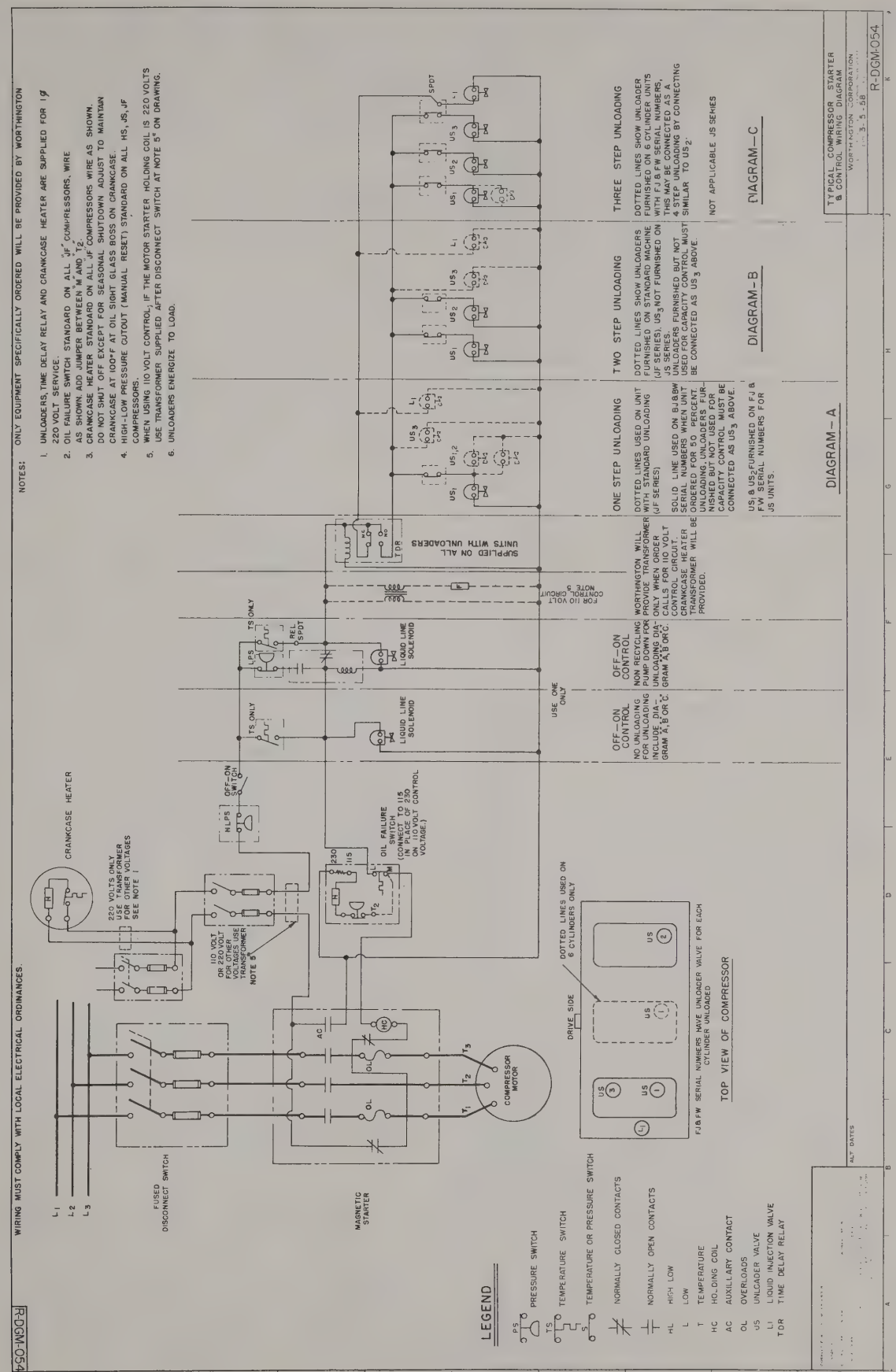
Check power characteristics of the motor to see that they correspond with the power supply.

Motors are to be connected through the magnetic starter to the terminals of the disconnect switch. The combination low pressure and high pressure cut-out is wired in series with the holding coil in the magnetic starter. See Drawing R-DGM-054

CAUTION: After completing the wiring, remove the "V" belts and carefully check rotation of motor, as compressor can be damaged if turned in the wrong direction. Arrow on condensing unit indicates proper direction of rotation. When viewed from flywheel end, correct rotation is clockwise.

TESTING:

A pressure test of the system will be required, for which proceed as follows:


NOTES:
ONLY EQUIPMENT SPECIFICALLY ORDERED WILL BE PROVIDED BY WORTHINGTON
1. UNLOADERS, TIME DELAY RELAY AND CRANKCASE HEATER ARE SUPPLIED FOR 1ø 220 VOLT SERVICE.
2. OIL FAILURE SWITCH STANDARD ON ALL "JF" COMPRESSORS, WIRE AS SHOWN. ADD JUMPER BETWEEN M AND T2.
3. CRANKCASE HEATER STANDARD ON ALL "JF" COMPRESSORS WIRE AS SHOWN. DO NOT SHUT OFF EXCEPT FOR SEASONAL SHUTDOWN. ADJUST TO MAINTAIN CRANKCASE AT 100°F AT OIL SIGHT GLASS BOSS ON CRANKCASE.
4. HIGH-LOW PRESSURE CUTOUT (MANUAL RESET) STANDARD ON ALL HS, JS, JF COMPRESSORS.
5. WHEN USING 110 VOLT CONTROL, IF THE MOTOR STARTER HOLDING COIL IS 220 VOLTS USE TRANSFORMER SUPPLIED AFTER DISCONNECT SWITCH AT NOTE 5* ON DRAWING.
6. UNLOADERS ENERGIZE TO LOAD.
WIRING MUST COMPLY WITH LOCAL ELECTRICAL ORDINANCES
L1
L2
L3
FUSED DISCONNECT SWITCH
MAGNETIC STARTER
CRANKCASE HEATER
220 VOLTS ONLY USE TRANSFORMER FOR OTHER VOLTAGES SEE NOTE 1
110 VOLT OR 220 VOLT FOR OTHER VOLTAGES USE TRANSFORMER NOTE 5*
OFF-ON SWITCH
NLPS
OIL FAILURE SWITCH (CONNECT TO 115 VOLTS OR 230 VOLTS ON 110 VOLT CONTROL VOLTAGE.)
TS ONLY
LIQUID LINE SOLENOID
LPS
REL SPDT
FOR 110 VOLT CONTROL CIRCUIT NOTE 3
SUPPLIED ON ALL UNITS WITH UNLOADERS
TDR
SPDT
USE ONE ONLY
DOTTED LINES USED ON 6 CYLINDERS ONLY
DRIVE SIDE
COMPRESSOR MOTOR
F/J & FW SERIAL NUMBERS HAVE UNLOADER VALVE FOR EACH CYLINDER UNLOADED
TOP VIEW OF COMPRESSOR
LEGEND
PS PRESSURE SWITCH
TS TEMPERATURE SWITCH
TEMPERATURE OR PRESSURE SWITCH
NORMALLY CLOSED CONTACTS
NORMALLY OPEN CONTACTS
HL HIGH LOW
L LOW
T TEMPERATURE
HC HOLDING COIL
AC AUXILLARY CONTACT
OL OVERLOADS
US UNLOADER VALVE
LI LIQUID INJECTION VALVE
TDR TIME DELAY RELAY
ONE STEP UNLOADING
DOTTED LINES USED ON UNIT WITH STANDARD UNLOADING (JF SERIES)
SOLID LINE USED ON BJ & BW SERIES UNITS WHEN UNIT ORDERED WITH ONE STEP UNLOADING. UNLOADERS FURNISHED BUT NOT USED FOR CAPACITY CONTROL MUST BE CONNECTED AS US3 ABOVE.
US1 & US2 FURNISHED ON F/J & FW SERIAL NUMBERS FOR JS UNITS.
DIAGRAM-A
TWO STEP UNLOADING
DOTTED LINES SHOW UNLOADERS FURNISHED ON STANDARD MACHINE (JF SERIES). US3 NOT FURNISHED ON JS SERIES.
UNLOADERS FURNISHED BUT NOT USED FOR CAPACITY CONTROL MUST BE CONNECTED AS US3 ABOVE.
DIAGRAM-B
THREE STEP UNLOADING
DOTTED LINES SHOW UNLOADERS FURNISHED ON 6 CYLINDER UNITS WITH F/J & FW SERIAL NUMBERS. THIS MAY BE CONNECTED AS A 4 STEP UNLOADING BY CONNECTING SIMILAR TO US2.
NOT APPLICABLE JS SERIES
DIAGRAM-C
OFF-ON CONTROL
NO UNLOADING FOR UNLOADING INCLUDE DIAGRAM A, B OR C.
OFF-ON CONTROL
NON RECYCLING PUMP DOWN FOR UNLOADING INCLUDE DIAGRAM A, B OR C.
WORTHINGTON WILL PROVIDE TRANSFORMER ONLY WHEN ORDER CALLS FOR 110 VOLT CONTROL CIRCUIT. CRANKCASE HEATER TRANSFORMER WILL BE PROVIDED.
TYPICAL COMPRESSOR STARTER & CONTROL WIRING DIAGRAM
WORTHINGTON CORPORATION
3-5-58
R-DGM-054
R-DGM-054
ALT DATES

Check the highest pressure permissible on all controls. If any cannot be subjected to the test pressure, they must be disconnected.

Connect a drum of refrigerant to the charging connection (See "CHARGING" instruction) and allow a small quantity of refrigerant to enter the system. Disconnect the drum of refrigerant and attach in its place a drum of dry Carbon Dioxide or Nitrogen. Slowly build up the pressure in the system to the required test pressure.

Brush all connections with soapsuds. Carefully inspect each connection as an interval of time may be required to form a bubble locating a leak. As a final test with system under pressure, wipe all soapsuds off, and using a Halide torch, check thoroughly all connections. A very small quantity of refrigerant under Carbon Dioxide pressure is sufficient to give a positive Halide torch test. If possible maintain the test pressure for three or four days. After correcting for temperature, there should be no greater loss than 2 or 3 p.s.i. When system is tight, purge to atmosphere and evacuate preparatory to charging with refrigerant.

EVACUATING THE SYSTEM:

It is recommended that a suitable auxiliary compressor be used to evacuate system. Connect evacuating compressor into system at any convenient valved opening. Be sure all openings to the system are closed, and that all electrical solenoid valves or line stop valves are open, so as not to isolate any portion of the system. Start evacuating compressor and allow unit to run until greatest vacuum it will pump is obtained, at least 29" on manometer is required. To insure adequate removal of moisture, the system must be evacuated to a point below the pressure corresponding to the boiling point of water at the ambient room temperature. The proper dehydration of a system requires considerable time, 24 to 48 hours depending upon the size of the system.

NOTE: Even small quantities of moisture are detrimental and many field difficulties are a direct result of moisture being present in the system. A Silica-Gel or Activated Alumina de-hydrator should be applied to the liquid line at time of installation, although it should not be left permanently in the system.

CHARGING:

The system should be tested and evacuated per the preceding instructions. Refrigerant may be charged into the system at several points.

A charging valve may be placed in the liquid refrigerant line between the receiver outlet shut-off valve (King Valve) and the evaporator. When charging the system at this point, close the King Valve and connect the refrigerant drum to the charging valve. With charging valve closed, loosen the charging connection at the valve, momentarily "crack" the valve on the refrigerant drum, allowing refrigerant to purge any air in the line through the loosened connection. When the air is vented, quickly tighten the charging line connection and open fully the charging valve. The valve on refrigerant drum should be slowly opened, allowing refrigerant to enter the system. When charging into the liquid line, the refrigerant drum should be turned upside down, so that only liquid refrigerant enters the liquid line.

Refrigerant may be charged directly into the evaporator or into the suction manifold on the compressor. In either case, connect the refrigerant drum to the charging valve and purge the air from the charging line as described above. When charging connection is tight, open the charging valve fully. The valve on the refrigerant drum should be slowly opened, allowing refrigerant gas only to enter into the system.

CAUTION: Keep refrigerant drum in upright position and carefully throttle the flow of refrigerant from the drum to the system. Be sure that refrigerant gas only is charged into the compressor suction as liquid refrigerant will damage the compressor.

IMPORTANT: After charging the system, use a Halide torch and carefully check both field and factory connections to be sure system is tight. Owing to the high density of the refrigerant gas, an extremely small leak will deplete the charge in a relatively short time.

GENERAL DESCRIPTION AND FUNCTION OF GAS UNLOADERS:

All control solenoid valves for gas type unloading, are supplied for operation on 220 Volt 60 Cycle Current Only. Other voltages available on special order.

Solenoid valves, used to control the unloading procedure, provide automatic increase or reduction of compressor capacity and power requirements. See drawings for unloaders.

With remote assembled Solenoid Valve Energized, the solenoid valve is Open, allowing high pressure gas to go to the unloader assembly, thus loading the compressor.

NOTE: Solenoid Valve Energized, means compressor unloader is in a loaded position.

With remote assembled Solenoid Valve De-energized, the solenoid valve is Closed, shutting the high pressure gas from the unloader assembly. Thus linkage spring action overcomes the high pressure gas, bleeding from the unloader piston chamber, pushing the unloader fingers and valve strips to their preset clearance. The result is that the unloader assembly is placed in an Unloaded position.

NOTE: Solenoid Valve De-energized means compressor unloader is in an Unloaded position. Compressor valves are held down toward the valve guard away from the valve strip seat.

DESCRIPTION OF UNLOADER ASSEMBLY:

The gas type unloader assembly consists of a rectangular block of steel, with a piston hole bored through its center to a determined depth, and a smaller hole drilled below this, through which the piston plunger extends to engage the assembly linkage.

The cylinder head and block mating surfaces are seat ground to provide a tight, smooth fit, eliminating the use of a gasket between the cylinder head and the block.

Two bolts *(with two metal spacers on each bolt) hold the unloader assembly in place in the center of the linkage assembly.

***NOTE:** NOT USED ON 3" MACHINE.

On the unloader cylinder head is mounted an adapter assembly that has a small tube extending upward toward the compressor cylinder head. This small tube connects with a flare fitting located in the cylinder head. At the bottom and within the flare fitting is a machined groove which holds a Neoprene O-Ring. The tubing of the adapter slips into this fitting and O-Ring when the cylinder head is placed on the compressor. This Neoprene O-Ring should be replaced each time the cylinder head is removed.

NOTE: All gaskets should be replaced each time cylinder head is removed.

All moving parts of the linkage assembly should be free to operate easily; binding of any part will cause the unloader to operate erratically and damage the valve strips.

The 3JS4 compressor is shipped with two unloaders for 50% unloading in one step. All other four cylinder compressors are shipped with three unloaders to provide 75% unloading. Three solenoid valves are furnished to control unloaders. A fourth solenoid is included for liquid injection.

On all six cylinder compressors, 66-2/3% unloading is provided with four unloaders and three solenoid valves controlling the unloaders. A fourth solenoid is included for liquid injection.

NOTE: To discontinue the use of one or more steps of unloading, provision must be made to disconnect the control solenoid, plugging the discharge part of the solenoid valve. Remove the flare fitting to the unloader, on the cylinder head, and use a

good brass pipe plug, making sure to dope with a refrigerant type pipe thread compound. Last of all, remove the complete unloader assembly from the compressor, and on replacing the cylinder head, install new gaskets.

REMOVAL OF VALVE AND UNLOADER ASSEMBLY:

Pump down unit, so that compressor heads can be removed. Shut off both Suction and Discharge line service valves, and bleed pressure out of the compressor, through the discharge gauge port connection.

Shut Off main fused switch to unit, and Remove All Fuses.

1. Proceed by removing the tubing from the remote solenoid valves to the cylinder head connections.

2. Remove head bolts and take cylinder heads off very carefully, as some resistance will be found, due to binding of the adapter tubing in the Neoprene O-Ring connection on the cylinder head. (Remove fitting first).

NOTE: Neoprene O-Ring gasket should be replaced each time the cylinder head is removed.

On 6JF4 and 6JF6 only, loosen the clamping plate jam screws located on the center rib of the cylinder head. On removing the cylinder head, remove the complete suction valve, clamping plate, and unloader assemblies.

3. Thoroughly examine the suction valve assembly for defective contact surfaces on the guard and seat, that might affect the proper functioning of the valve strips. Also, thoroughly examine the valve strips for breakage, or other damage.

NOTE: If defective parts are found, replace with new, first determining cause of damage to old part.

4. Remove the complete unloader assembly from the valve plate, by removing the four screws (one in each corner).

5. Remove unloader cylinder head by unscrewing Allen head screws located under the tube adapter. Inspect piston action, and if signs of excess wear are found, replace complete unloader assembly.

UNLOADER FINGER ADJUSTMENT:

1. On 3JF4, 3JF6, 4JF4 and 4JF6 models, the unloader linkage cage and unloader assembly are mounted directly on the valve plates.

2. Place a feeler gauge through the valve guard between the guard and valve strips, before depressing valve strips for adjustment. Feeler gauge should be set to allow for .003 to .005 clearance.

3. Loosen the top eccentric nut so that easy movement will change the adjustment. With the feeler gauge in place, insert a screw driver in back of the center linkage roller, and push, so that the linkage arms are extended as far as they will go.

4. Insert a nail or punch type instrument through one of the holes in the eccentric bolt, and turn eccentric bolt until the unloader fingers depress the valve strips and feeler gauge against the valve guard. Feeler gauge should slip out straight with a slight pull or drag against the valve guard. Lock the eccentric bolt in position by tightening the locknut.

5. On 6JF4 and 6JF6 compressors, the unloader linkage cage and unloader assemblies are mounted directly on the suction valve assembly. The linkage cage has two bolts (one on each side) which go through two elongated holes permitting assembly to be raised or lowered.

A. Depress the complete unloader assembly until the unloader fingers are in a straight extended position.

B. Using an ell shaped feeler gauge inserted from the bottom of the suction valve guard, adjust fingers so that .003 to .005 clearance is provided between valve strips and suction valve guard. When this is accomplished, lock the bolts

in position, by tightening the locknut.

IMPORTANT: When the adjustment is locked, care should be taken that each end of the unloader assembly is exactly level, so that all valve strips will have the same clearance between valve guards.

C. Recheck all gauge settings.

6. On 6JF4 and 6JF6 only, place the assembled suction valve, clamping plate, and unloader on a bench, and test the adjustment by inserting a screw driver behind the linkage, and push the spring back and forth several times.

Check the unloader fingers in the loaded position, making sure that the fingers lift clear of the valve strips, or compressor capacity loss will result, causing valve strip breakage.

7. Check linkage assembly for excessive looseness or binding.

REINSTALLING VALVE AND UNLOADER ASSEMBLY:

When installing a valve and unloader assembly, place new gaskets on both sides of valve plate and valve guard to cylinder head gaskets.

1. On 6JF4 and 6JF6 only, place the assembly in its proper position in the compressor head.

2. Insert the three hold-down screws in the clamping plate, and fasten finger tight. Screw down, finger tight, the two jam screws located in the end positions of the center rib of the head, to hold down the suction valve and clamping plate.

NOTE: If there are three jam screws in the center rib, remove and discard the center jam screw, (6JF4 and 6JF6 only).

3. Using a torque wrench, tighten the hold-down and jam screws, in criss-cross rotation, from center to ends, increasing the pressure 5 foot pounds with each circuit of the screws, until a maximum of forty pounds pressure has been applied to each screw.

NOTE: It is very important that the hold-down and jam screws be tightened evenly to prevent the valves from becoming cocked, or improperly seated. (6JF4 and 6JF6 only). After the valve and unloader assembly has been properly secured in position, push down and release the unloader plunger several times, to be certain the unloader linkage functions freely.

4. Replace cylinder head and/or cover, using all new gaskets.

5. Tighten the cylinder head and/or cover screws, in rotation, using a torque wrench.

NOTE: If the compressor has the type of cylinder head where the screws extend through the cover and cylinder head into the crankcase, use a maximum of 45 foot pounds on each screw.

If the compressor has the type of cylinder head where the screws extend only into the cylinder head, use a maximum of 35 foot pounds on each screw.

When tightening the screws in rotation, it is recommended that an increase of approximately 5 foot pounds pressure be applied with each circuit of the screws.

After the replacement of all parts is accomplished, refrigerant pressure should be introduced back into the compressor, so that a good Halide Leak Detector test can be made. It is a good precautionary practice to check the compressor completely, not only the parts that were removed.

NOTE: Check oil level, belt and belt alignment, and controls, to make sure none are by-passed or inoperative.

MULTI STEP UNLOADING

LIQUID INJECTION:

1. Drawing HX-16927 shows location of

Liquid Injection Valve in the compressor head.

A. This is item five on the drawing, and is installed in the compressor head, having the last step of unloading.

B. Item four is a solenoid valve for installation in the liquid line to injector.

2. Drawing HX-16927 shows the valve which is installed in the compressor head with the nozzle attached. On 3" machines, the valve does not contain a nozzle, due to space limitation in the compressor head.

3. Drawing R-DGM-054 is a typical diagram for electrical wiring supplied with all compressors. Diagram "A" shows connections for one step unloading. Diagram "B" shows two step unloading. Diagram "C" shows three step unloading.

UNLOADING SEQUENCE:

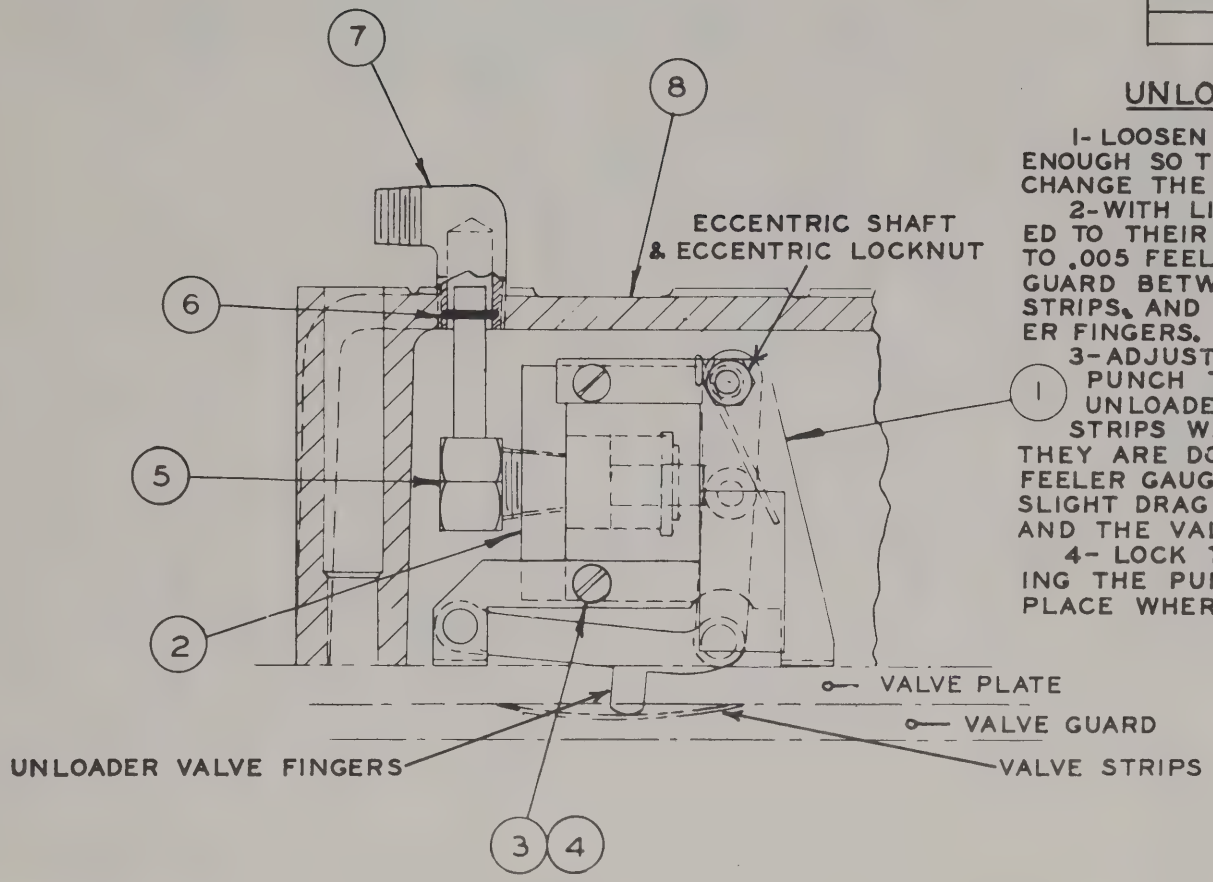
The first step unloader (U51) control is a normally closed switch, which opens on a drop in pressure or temperature, de-energizing the unloader solenoid, thereby unloading the cylinder.

The second (2nd) step unloader control (U52) is a normally closed switch which de-energizing the unloader solenoid, thereby unloading the cylinder.

The third (3rd.) step unloader control (U53) is a two (2) position switch normally closed on the second (2nd.) position. This switch opens on a drop in pressure or temperature, de-energizing the unloader solenoid, thereby unloading the cylinder. At the same time, switch closes position number one (1) energizing the solenoid in the liquid line to the liquid injector, allowing the valve to open, and a small quantity of liquid refrigerant will be sprayed on the last step unloader, cooling the gas in the head.

FOR CAPACITY INCREASE, OPERATION IS THE REVERSE OF ABOVE. THE AMOUNT OF LIQUID REFRIGERANT SPRAYED ON THE UNLOADER IS ADJUSTED ON THE INITIAL TEST, BY ADJUSTING THE VALVE LOCATED ON THE COMPRESSOR HEAD AND SHOULD THEN BE CONSTANT FOR ALL CONDITIONS OF SERVICE.

ITEM	NAME OF PART
1	UNLOADER FRAME
2	UNLOADER POWER UNIT
3	8 - 32 x 1½ SCREW RD. - HD.
4	8 - 32 FLEXLOC NUT
5	ADAPTER ASSEMBLY
6	"O" RING
7	ELBOW
8	3 JF HEAD



UNLOADER ADJUSTMENT

1- LOOSEN TOP ECCENTRIC NUT JUST ENOUGH SO THAT EASY MOVEMENT WILL CHANGE THE ADJUSTMENT.

2- WITH LINKAGE ARMS STRAIGHT OR EXTENDED TO THEIR EXTREME POSITION. PLACE A .003 TO .005 FEELER GAUGE THROUGH THE VALVE GUARD BETWEEN THE GUARD AND THE VALVE STRIPS, AND DIRECTLY BENEATH THE UNLOADER FINGERS.

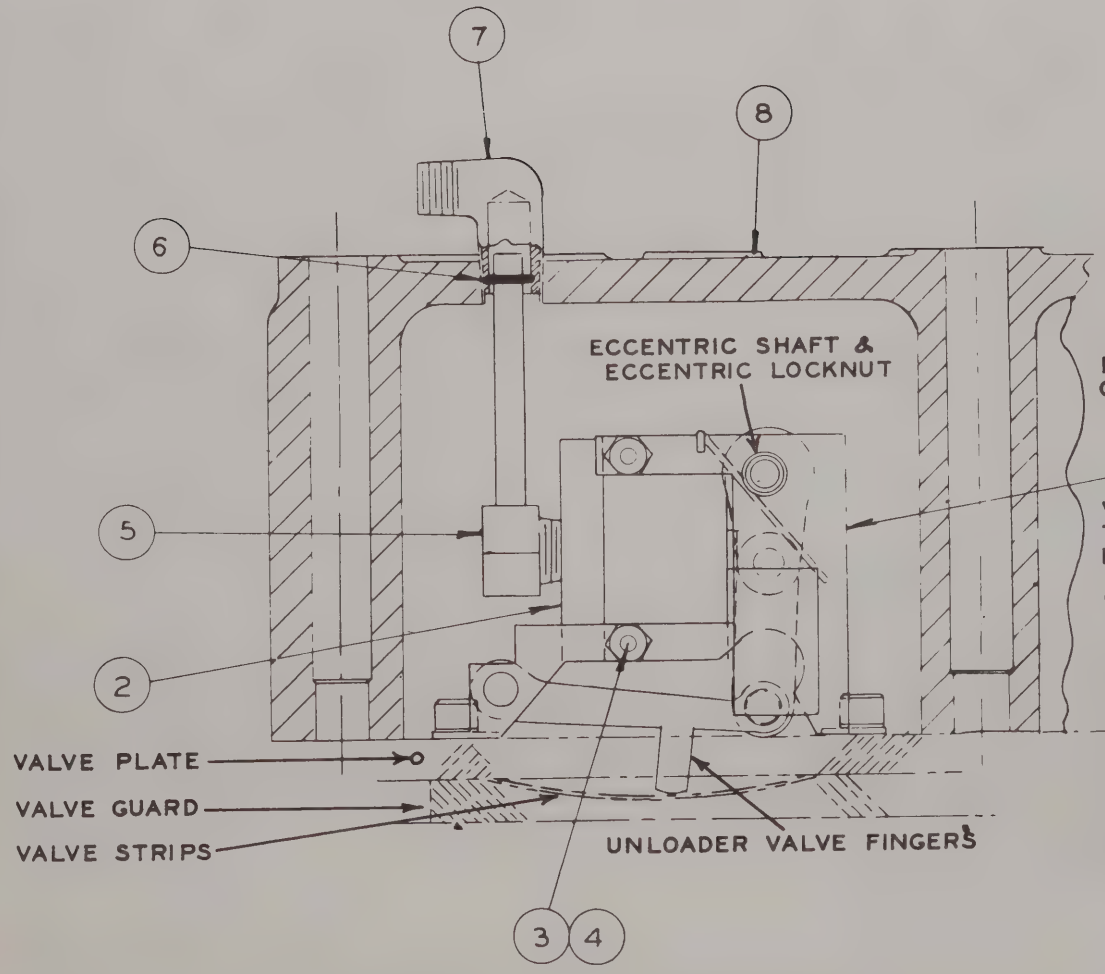
3- ADJUST THE ECCENTRIC BOLT. WITH A PUNCH TYPE INSTRUMENT. UNTIL THE UNLOADER FINGERS DEPRESS THE VALVE STRIPS WITH THE FEELER GAUGE, UNTIL THEY ARE DOWN AGAINST THE VALVE GUARD. FEELER GAUGE AT THIS POINT SHOULD HAVE A SLIGHT DRAG BETWEEN THE VALVE STRIPS AND THE VALVE GUARD.

4- LOCK THE ECCENTRIC LOCKNUT, HOLDING THE PUNCH TYPE INSTRUMENT IN THE PLACE WHERE FEELER GAUGE WAS CORRECT.

HY-14145

UNLOADER ASSEMBLY FOR 3JF & 5 COMPRESSORS

ITEM	NAME OF PART
1	UNLOADER FRAME
2	UNLOADER POWER UNIT
3	8 - 32 x 2½ SCREW
4	8 - 32 FLEXLOC NUT
5	ADAPTER ASSEMBLY
6	"O" RING
7	ELBOW
8	4JF HEAD
9	SPACER



UNLOADER ADJUSTMENT

1- LOOSEN TOP ECCENTRIC NUT JUST ENOUGH SO THAT EASY MOVEMENT WILL CHANGE THE ADJUSTMENT.

2- WITH LINKAGE ARMS STRAIGHT OR EXTENDED TO THEIR EXTREME POSITION, PLACE A .003 TO .005 FEELER GAUGE THROUGH THE VALVE GUARD BETWEEN THE GUARD AND THE VALVE STRIPS, AND DIRECTLY BENEATH THE UNLOADER FINGERS.

3- ADJUST THE ECCENTRIC BOLT, WITH A PUNCH TYPE INSTRUMENT, UNTIL THE UNLOADER FINGERS DEPRESS THE VALVE STRIPS WITH THE FEELER GAUGE, UNTIL THEY ARE DOWN AGAINST THE VALVE GUARD. FEELER GAUGE AT THIS POINT SHOULD HAVE A SLIGHT DRAG BETWEEN THE VALVE STRIPS AND THE VALVE GUARD.

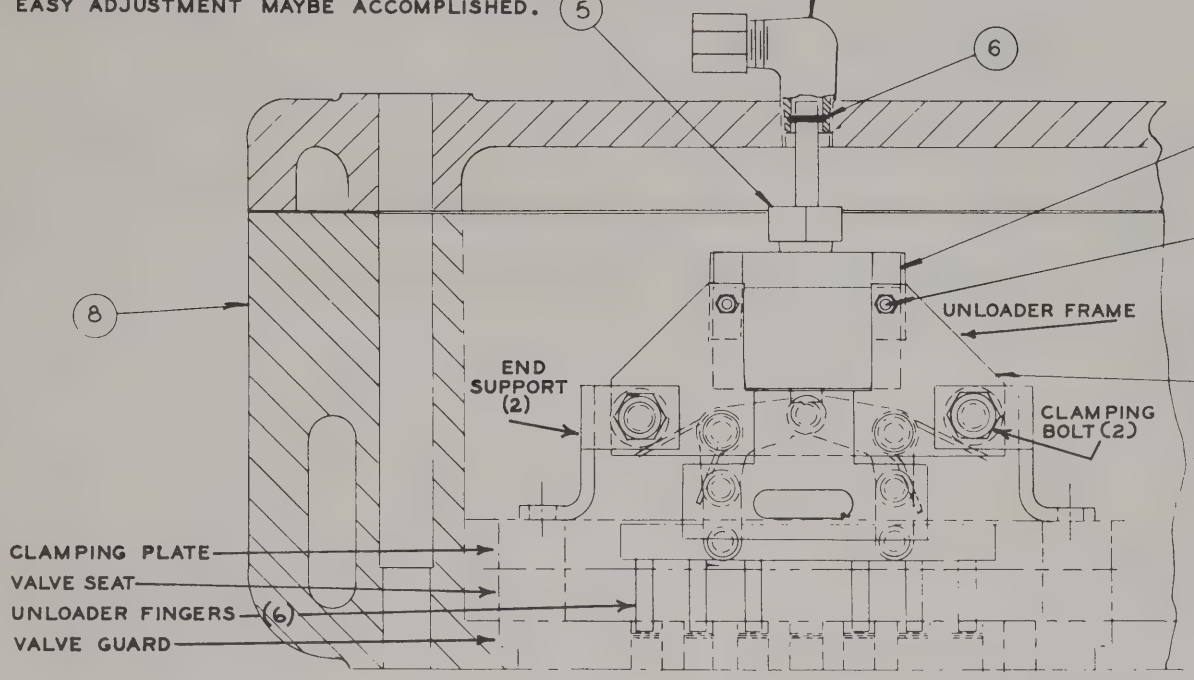
4- LOCK THE ECCENTRIC LOCKNUT, HOLDING THE PUNCH TYPE INSTRUMENT IN THE PLACE WHERE FEELER GAUGE WAS CORRECT.

HY-14146

UNLOADER ASSEMBLY FOR 4JF COMPRESSORS

UNLOADER ADJUSTMENT

1- THE ADJUSTMENT ON THE 6JF COMPRESSOR UNLOADER ASSEMBLIES, WILL BE SLIGHTLY DIFFERENT.
2- THE LINKAGE CAGE HAS TWO BOLTS THAT GO THRU THE UNLOADER POWER ASSEMBLY, WHICH ALSO GO THRU TWO ELONGATED HOLES, (7) ELONGATED IN A VERTICAL POSITION IN THE CAGE.
3- THIS ALLOWS THE ADJUSTMENT OF THE POWER ASSEMBLY UP OR DOWN WITH THE UNLOADER FINGERS EXTENDED TO THEIR EXTREME MAXIMUM POSITION.
4- LOOSEN BOLTS JUST ENOUGH SO THAT EASY ADJUSTMENT MAYBE ACCOMPLISHED.



ITEM	NAME OF PART
1	UNLOADER FRAME
2	UNLOADER POWER UNIT
3	8 - 32 x 2 SCREW
4	8 - 32 FLEXLOC NUT
5	ADAPTER ASSEMBLY
6	"O" RING
7	ELBOW
8	6 JF HEAD

5- BY CUTTING .003 TO .005 SHIM STOCK IN STRIPS, YOU CAN INSERT FEELER STOCK FROM THE TOP, BUT UNDER THE UNLOADER FINGERS AND ON TOP OF THE VALVE STRIPS. OR YOU CAN BEND THE SHIM STOCK ELL SHAPE AND INSERT FROM UNDERNEATH THE VALVE GUARD.

6- PRESS DOWN THE POWER ASSEMBLY, AND LOCK IN PLACE AS SOON AS POSITION OF FEELER AND VALVE STRIPS ARE DOWN AGAINST THE VALVE GUARD, JUST SO THAT YOU HAVE A SLIGHT DRAG OF FEELER.

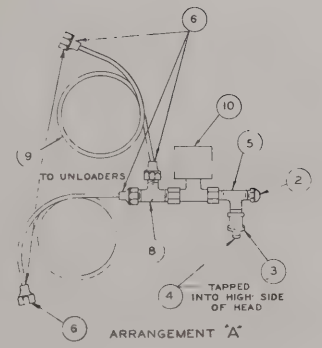
7- IMPORTANT: WHEN THE ADJUSTMENT IS LOCKED IN PLACE, CARE SHOULD BE TAKEN THAT EACH END OF THE POWER ASSEMBLY IS EXACTLY LEVEL, SO THAT ALL VALVE STRIPS HAVE THE SAME CLEARANCE.

8- AFTER LOCKING IN POSITION, RECHECK ALL THE GAUGE SETTINGS.

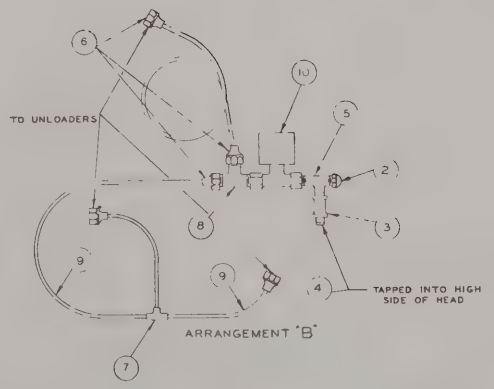
9- UNLOADER FINGERS SHOULD BE UP CLEAR OF THE VALVE STRIPS, WHEN IN A LOADED POSITION

HY-14149

UNLOADER ASSEMBLY FOR COMPRESSORS 6JF



ARRANGEMENT "A"



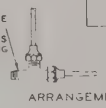
ARRANGEMENT "B"

COMPRESSOR	AMT OF U.	STEP	ARRANGEMENT	CNT	HEAD ASSY
COM-349C 3J54	50 %	1 STEP	A	CNT-202	(2)HD-592
	50 %	2 STEP	C & C	CNT-204	(4)HD-592
COM-350D 3JF4	50 %	1 STEP	A	CNT-202	(2)HD-592
	50 %	2 STEP	C & C	CNT-204	(4)HD-592
	75 %	3 STEP	C & D	CNT-206	1 HD-592
COM-351D 3JF6	50 %	1 STEP	B	CNT-203	(3)HD-592
	50 %	2 STEP	A & C	CNT-205	(3)HD-592
	50 %	3 STEP	C & C & C	CNT-208	(3)HD-592
	66⅔ %	3 STEP	C & E	CNT-207	(2)HD-592
COM-352D 4JF4	50 %	1 STEP	A	CNT-	(2)HD-594
	50 %	2 STEP	C & C	CNT-204	(4)HD-594
	75 %	3 STEP	C & D	CNT-206	1 HD-594
COM-354D 4JF6	50 %	1 STEP	B	CNT-203	(3)HD-594
	50 %	2 STEP	A & C	CNT-205	(3)HD-594
	50 %	3 STEP	C & C & C	CNT-208	(3)HD-594
	66⅔ %	3 STEP	C & E	CNT-207	(2)HD-594
COM-356E 6JF4	50 %	1 STEP	A	CNT-202	(2)HD-596
	50 %	2 STEP	C & C	CNT-204	(2)HD-596
	75 %	3 STEP	C & D	CNT-206	1 HD-596
COM-358E 6JF6	50 %	1 STEP	B	CNT-203	(3)HD-596
	50 %	2 STEP	A & C	CNT-205	(3)HD-596
	50 %	3 STEP	C & C & C	CNT-208	(3)HD-596
	66⅔ %	3 STEP	C & E	CNT-207	2)HD-596

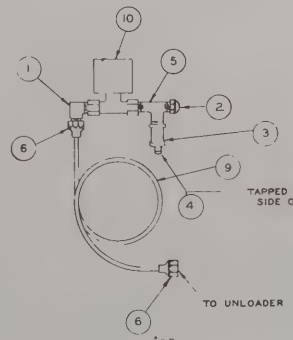
	PART NO	NO OF PIECES PER UNIT			NAME OF PART	MAT	PATT NO
1	ELL-798	1	1	2	⅜ MPT x ¼ FL ELL	BRS	
2	CAP-546	1	1	1	⅜ NPT PIPE CAP	ST	
3	ELL-962	1	1	1	⅜ x 45° ELL FORGED	ST	
4	NIP-1129	1	1	1	⅜ x 1½ LG NIPPLE	ST	EX. HVY.
5	TEE-762	1	1	1	⅜ MPT TEE STRAIN	BRS	EX-TEE-762
6	NUT-402	4	5	24	¼ FLARE NUT	BRS	
7	TEE-510	1	1		¼ SWEAT TEE	CU	
8	TEE-765	1	1		⅜ MPT x ¼ x ⅜ TEE	BRS	
9	TUB-508	ON REEL			¼ TUBING	CU	
10	VAL-822	1	1	2	SOLENOID VALVE		

ARRANGEMENT-A
ARRANGEMENT-B
ARRANGEMENT-C
ARRANGEMENT-D

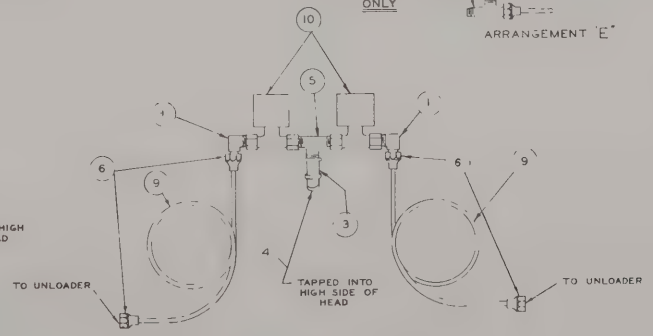
USE TEE-765 IN PLACE OF ELL-798 FOR 6 CYLINDER COMPRESSORS WITH 66⅔ % UNLOADING ONLY



ARRANGEMENT "E"



ARRANGEMENT "C"



ARRANGEMENT "D"

NOTE: ALL ARRANGEMENTS ARE MOUNTED ON THE HEADS. SEE COMPRESSOR HEAD DRAWING FOR LOCATION OF TAP HOLE

REFERENCE FOR LOCATION OF UNLOADERS & SEQUENCE OF STEP UNLOADING SEE DWG. HX-14252

HR-14240

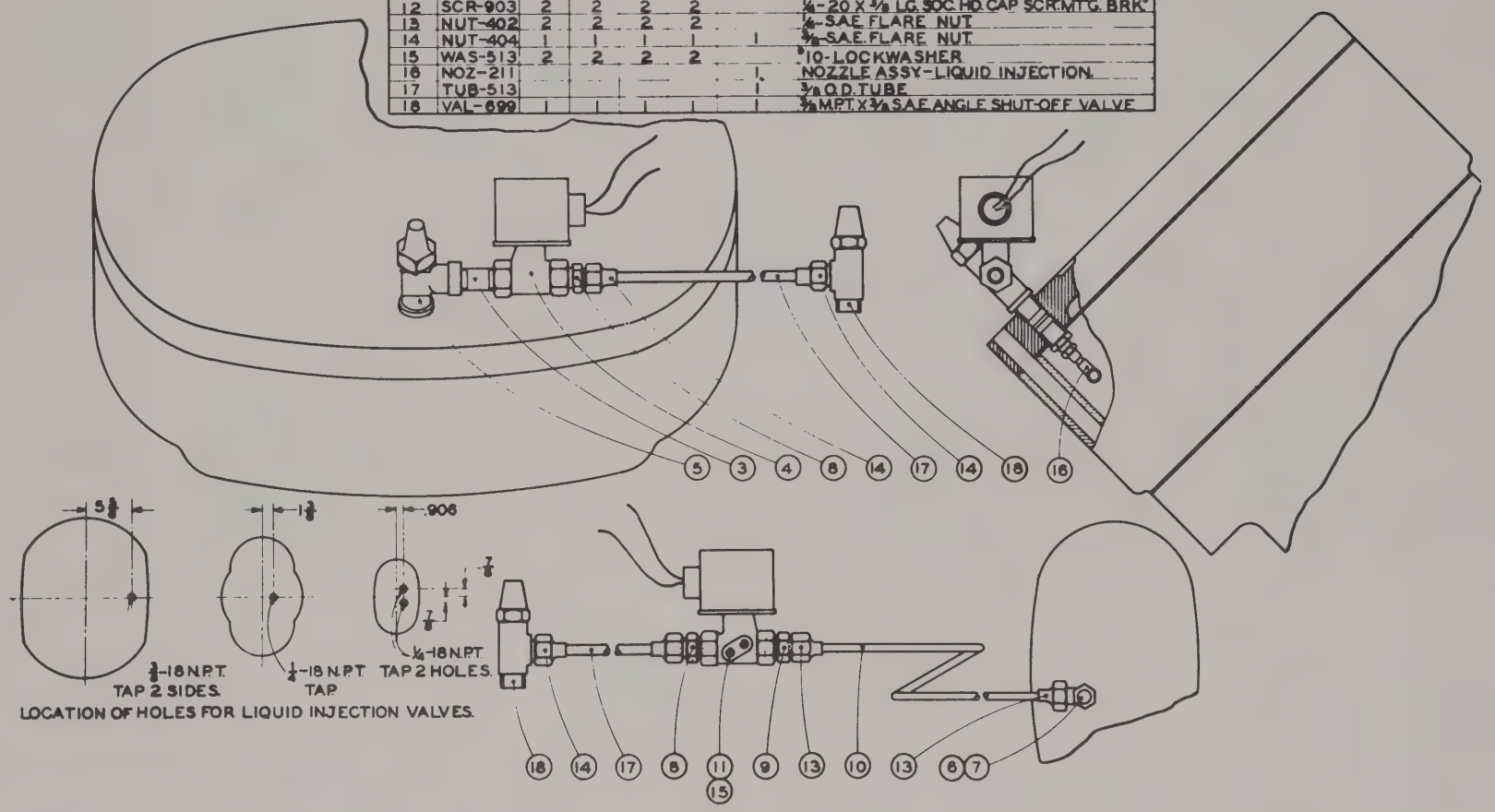
SUPERSEDES DRAWING SAME NUMBER DATE 9-30-54

EXTERNAL GAS UNLOADER PARTS ASS'Y FOR "J" LINE COMPRESSOR 50% 66⅔-75% UNLOADING - 1-2 & 3 STEP

WORTHINGTON

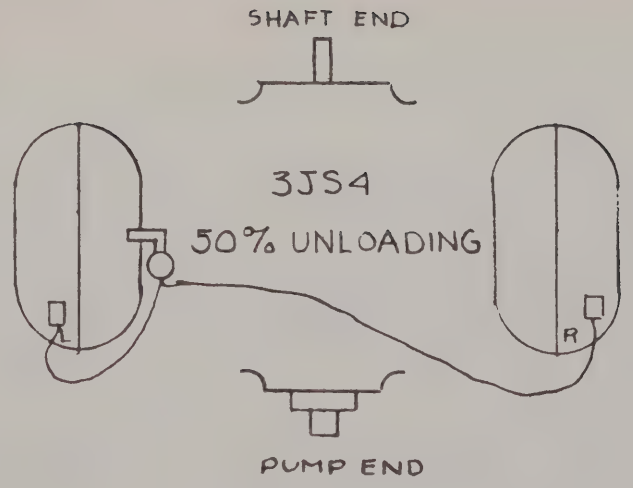
NOTE: ITEM-1 THRU 15 ARE PARTS FURNISHED AS STANDARD EQUIPMENT ONLY ON PRODUCTION MODEL COMPRESSORS. ITEMS-16 & 17 NOT FURNISHED BY WORTHINGTON.

ITEM	PART NO.	3JF4	3JF6	4JF4	4JF6	6JF4&6	DESCRIPTION
1	BRK-1220	1		1			MOUNTING BRACKET.
2	BRK-1221		1		1		MOUNTING BRACKET.
3	NIP-1129					1	NIPPLE-3/8 M.P.T. X 1 1/2 LG.
4	VAL-822	1	1	1	1	1	SOLENOID VALVE.
5	VAL-1199					1	3/8 M.P.T. X 3/8 F.P.T. ANGLE THROTTLING VALVE.
6	VAL-1102			1	1		1/4 M.P.T. X 1/4 S.A.E. ANG. SHUTOFF VALVE ASS'Y.
7	VAL-697	1	1				1/4 M.P.T. X 1/4 S.A.E. ANG. SHUTOFF VALVE.
8	CPL-626	1	1	1	1	1	COUPLING-3/8 M.P.T. X 3/8 FLARE.
9	CPL-636	1	1	1	1		COUPLING-3/8 M.P.T. X 1/4 FLARE.
10	TUB-506	1	1	1	1		1/4 O.D. TUBE.
11	SCR-1658	2	2	2	2		*10-32 X 3/8 LG. ALLEN SCREW.
12	SCR-903	2	2	2	2		1/4-20 X 3/8 LG. SOC. HD. CAP SCR. MT'G. BRK.*
13	NUT-402	2	2	2	2		1/4-S.A.E. FLARE NUT.
14	NUT-404	1	1	1	1	1	3/8-S.A.E. FLARE NUT.
15	WAS-513	2	2	2	2		*10-LOCKWASHER
16	NOZ-211					1	NOZZLE ASSY-LIQUID INJECTION.
17	TUB-513					1	3/8 O.D. TUBE.
18	VAL-699	1	1	1	1	1	3/8 M.P.T. X 3/8 S.A.E. ANGLE SHUT-OFF VALVE.

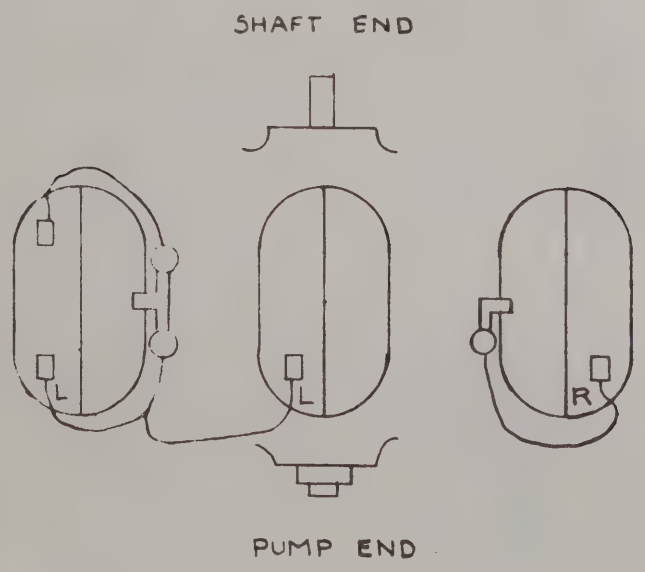


LOCATION OF HOLES FOR LIQUID INJECTION VALVES.

HX 16927

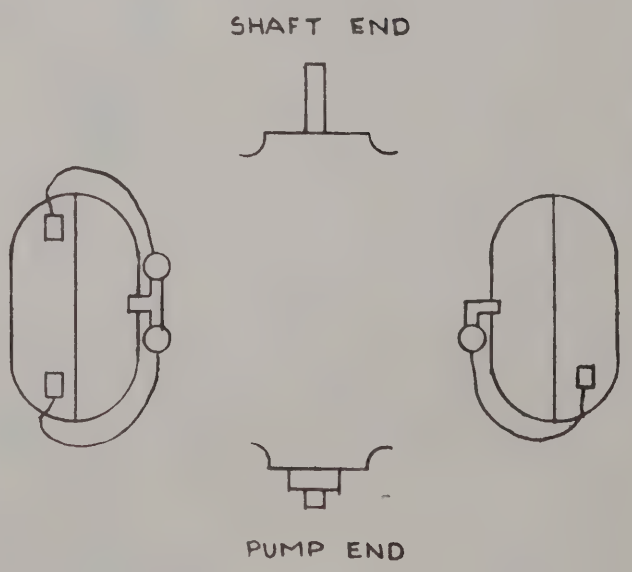


6 CYLINDER



66⅔% UNLOADING

4 CYLINDER

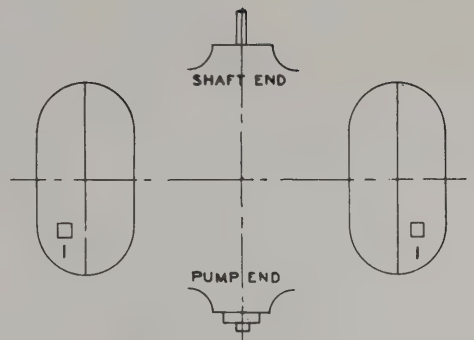


75% UNLOADING

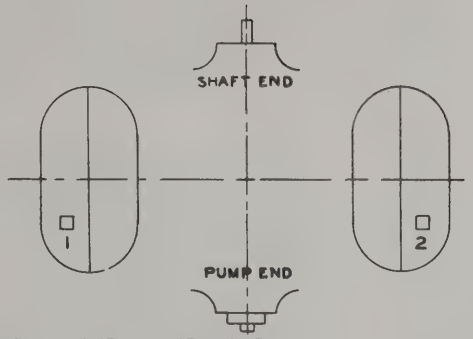
HY-14237

STANDARD ARRANGEMENT FOR FREON, HEAD MANIFOLDED GAS UNLOADERS ON "J" LINE REFRIGERATION COMPRESSORS

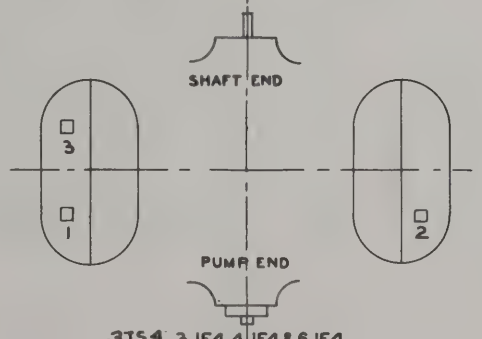
NOTE: NUMBERS ON HEADS INDICATES STEPS OF UNLOADING. EXAMPLE: 1= FIRST STEP
2= SECOND STEP
3= THIRD STEP



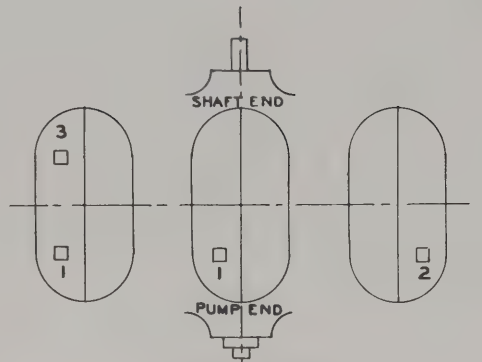
3JS4, 3JF4, 4JF4, 6JF4
50% UNLOADING
1 STEP



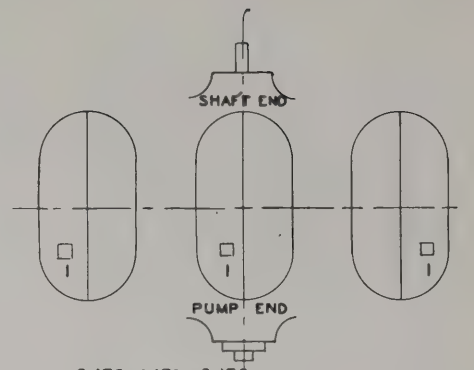
3JS4, 3JF4, 4JF4, 6JF4
50% UNLOADING
2 STEP



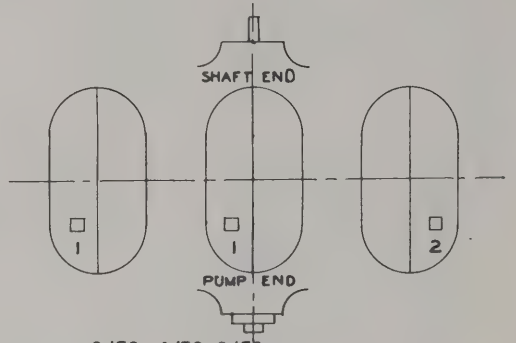
3JS4, 3JF4, 4JF4 & 6JF4
75% UNLOADING
3 STEP



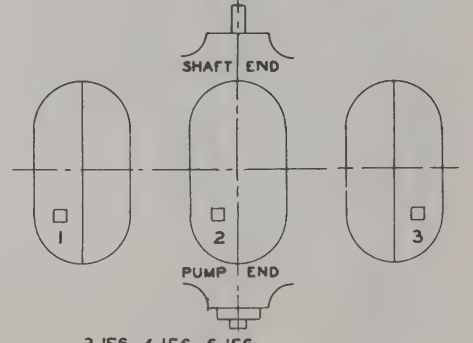
3JF6, 4JF6, 6JF6
66 2/3% UNLOADING
3 STEP



3JF6, 4JF6, 6JF6
50% UNLOADING
1 STEP



3JF6, 4JF6, 6JF6
50% UNLOADING
2 STEP



3JF6, 4JF6, 6JF6
50% UNLOADING
3 STEP

HX-14252

ARRANGEMENT OF UNLOADER LOCATION AND STEP SEQUENCE FOR FREON REFRIGERATION COMPRESSORS

WORTHINGTON

LUBRICATION

OILS - RECIPROCATING REFRIGERATION COMPRESSOR LUBRICATING SPECIFICATIONS FOR USE WITH R-12, R-22

Oil, per specifications listed below, can be furnished by any reputable oil company and should be purchased subject to guarantee by the supplier as to suitability for the use intended:

	Temperature range down to:		
	-120°F	-40°F And Above	0°F * And Above
1. Viscosity SSU @ 100°F	150-160	280-300	500-560
SSU @ 210°F	41	47	
2. Gravity API @ 60°F	21.5-23.5	20.4-22.4	20.0-22.0
3. Flash Point ASTM Open Cup	330-340°F	350-360°F	375 Min.°F
4. Fire Point	370-390°F	400-420°F	435 Min.°F
5. Pour Point Test ASTM (Max.)	-35°F	-25°F	-10°F
6. Color ASTM	1 Max.	2 Max.	2 Max.
7. Neutralization No.	Neutral	Neutral	Neutral
8. Steam Emulsion No. (Max.)	50	70	100
9. Dielectric Strength	25KV	25KV	25KV
10. Sligh Oxidation	10-20	10-20	5-15
11. Floc Test For Wax (Max.)	-70°F	-50°F	-40°F

* The 150 viscosity oil should be used between -40°F and -120°F. Above -40°F the 300 viscosity oil should be used. The 500 viscosity oil can be used above 0°F if desired.

NOTE: If crankcase temperatures reach 135°F, a heavier viscosity oil will have to be specified, or an external oil cooler used.

Use a good grade of refrigeration machine oil in refinery sealed containers as recommended by the refinery for the application. See Fig. 4 for amount of oil charge.

Compressors shipped from the factory are charged with oil to 3/4 high on the bulls eye. The recommended oil level during normal operation is 1/4 high on the bulls eye. The additional oil is intended to satisfy the oil requirements of the system and it may be necessary to add or remove oil depending upon the size of the system.

COMPRESSOR MODEL NO.	COMPRESSOR PART NO.	OIL CAPACITY (QUARTS)
3JS4	COM-349	4 qts.
3JF4	COM-350	4 qts.
3JF6	COM-351	10 qts.
4JF4	COM-352	12 qts.
4JF6	COM-354	12 qts.
6JF4	COM-356	36 qts.
6JF6	COM-358	36 qts.

Fig. 4

MECHANICAL WARRANTY

Worthington Corporation warrants the products so far as the same are of its own manufacture, against defects in material or workmanship, under normal use and service, for a period of one (1) year from date of shipment, Worthington's obligation under this warranty being limited, however, to the repairing or replacing, at its option, free of charge, FOB point of manufacture any part that proves to have been defective in material or workmanship at the time of shipment, provided that Worthington is given immediate written notice and full information about the defect, and the part is delivered FOB Worthington's factory for inspection, when requested.

Equipment manufactured or supplied by others, but furnished by Worthington carries the same warranty that the manufacturer or supplier thereof furnished to Worthington. Worthington shall not be liable for repairs or replacements made without its written consent, nor for damages, delays and losses, consequential or otherwise, caused by defects, its liability being expressly limited to repair or replacement as stated herein. There are no warranties, expressed or implied, except the above.

FREON CONDENSING UNITS

GENERAL INSTRUCTIONS

BELTS:

To keep V-belt wear to a minimum, the compressor and motor sheaves must be in exact alignment, and the belts free from water and oil. Do not use belt dressing.

V-belts are furnished in matched sets, and replacements can be obtained from Worthington.

REMOVING BELTS:

Open motor disconnect switch.

Remove belt guard.

Loosen motor bolt nuts.

Move motor toward compressor to loosen belts by turning adjusting bolts. Both adjusting bolts should be turned the same number of times to keep motor square. Adjusting bolts will work freely, and not bind if they are turned a few turns at a time, alternately. Move motor far enough toward compressor to allow easy removal of belts from motor sheave.

Remove belts. Do not pry off, or attempt to force them.

REINSTALLING BELTS:

If installing new belts, always use a complete set of new matched belts. Never use a mixed set of new and old belts, as the old belts will have stretched and will place a strain on the new belts.

Be sure the motor has been moved far enough toward the compressor to allow the installation of the belts without forcing.

Install the belt nearest to the inside of the sheaves first. Lay all belts evenly in the grooves with all of the slack on either the top or bottom of the sheave. Do not have the slack of some belts on top and some on the bottom. See Fig. 5.

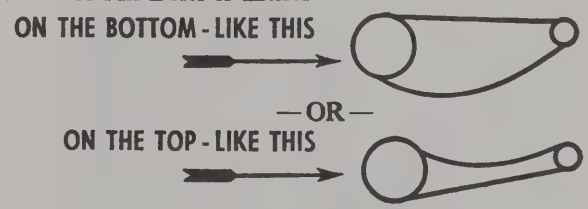
Move motor away from compressor to tighten belts, by turning adjusting bolts. Turn bolts equal number of times, turning bolts alternately a few turns at a time to keep motor square.

Tighten belts sufficiently to prevent belt squeal. Belts should not be pulled too tight; a good way to check belt tension is to place your finger on one of the belts at a point midway between compressor sheave and motor sheaves and press down. You should be able to depress belt approximately 1" below the other belts, if properly tightened.

With belts properly tightened and motor square, tighten motor bolt nuts.

Reinstall belt guard.

Work Belts around in the Groove by Hand, so that the Slack of All Belts is Either



NEVER LIKE THIS

With slack of some belts on bottom (see solid line) and slack of others on top (see dotted line).

Since V-Belts will not slide in the groove, belts thus applied will be injured when tightened for operation.

Fig. 5

REMOVING COMPRESSOR:

Remove belt guard and belts as covered under "BELTS".

Remove compressor sheave.

NOTE: Loosen sheave lockmut and break sheave loose with wheel-puller. Remove lockmut and lockwasher. Then take off sheave.

When replacing a 3 in. compressor, remove suction service valve and suction mani-

fold also discharge valve. Replacement 3 in. compressors do not include the manifold or elbow. On the 4 in. and 6 in. compressors, manifolds are supplied, therefore remove only suction and discharge service valves. Support both suction and discharge lines to carry theweight of valves.

Disconnect control lines from high-low pressure safety cut-out to compressor. Remove compressor bolts, and slide compressor off the base.

After removing compressor, be sure all openings to the atmosphere are closed to prevent air entering compressor, and causing corrosion. The threads on the end of the crankshaft should be protected for shipping. This can be done by turning on locknut until flush with shaft end, and tape to prevent nut from becoming lost.

Crate compressor, being sure the shaft is in the clear, but is protected against damage. Return compressor less sheave, suction and discharge valves, to the factory.

REINSTALLING COMPRESSOR:

If a replacement compressor from the factory is being used, carefully uncrate compressor, and inspect it to be sure it has not been damaged in shipping; if so, refer to page 4, "INSPECTION".

Remove plugs, or blank flanges from suction, and discharge line openings, also control line openings on compressor.

Place compressor in position and fasten with bolts.

Install compressor sheave, being sure that shaft and bore of sheave are free from dirt, and foreign matter, such as paint etc., and that the shaft key is properly in place. Install lockwasher and locknut and tighten sheave in place by pulling up on locknut. Always be sure sheave is tight on shaft, as a loose sheave will knock, and cause noisy compressor operation and if so continued, will cause internal trouble.

Install bolts on suction line valve, and tighten in place.

Use a new gasket between suction valve and manifold, first being sure that both gasket surfaces are clean. Pull up on all bolts evenly to assure a proper seat on gasket to prevent leaks.

Install bolts on discharge valve, and tighten into place evenly, to assure a proper seat.

Reconnect control safety lines from high-low pressure safety cut-out to compressor.

Reinstall belts and belt guard as covered under "BELTS".

Evacuate and pressure test compressor.

When satisfactorily evacuated and pressure tested, place unit back in operation.

After unit has been in operation a short time check for leaks.

REMOVING MOTOR:

Remove belt guard and belts as described under "BELTS".

Remove sheave pull up bolts and remove QD drive sheave from split hub on motor shaft. Do not drive off sheave as you may damage sheave or motor. Use Jack screws to loosen sheave from hub.

Remove motor bolts.

Disconnect wiring from motor leads and electrical conduit from motor terminal box.

Remove motor from base.

If motor is to be returned to the factory, it should be carefully crated to prevent damage to motor during shipment.

REINSTALLING MOTOR:

If a new motor is being used, check motor nameplate. The electrical characteristics of motor should correspond to the power supply available, also the correct size and type.

Place motor on base and replace motor bolts. Do not tighten. Connect wiring to motor leads.

NOTE: Before soldering connections, be sure motor is rotating in right direction. Standard direction of rotation is clockwise, when facing motor sheave.

Solder wiring connections and tape with both rubber and friction tape. Reinstall terminal box cover.

Install motor sheave and tighten on shaft, being sure that motor sheave is properly aligned with compressor sheave. Misalignment will cause excessive wear on belts.

Reinstall belts and drive guard as covered under "BELTS".

SAFETY HI-LO PRESSURE CONTROL:

Each Worthington condensing and compressor unit is furnished with a combination hi-lo pressure cut-out. This is a safety control, and not an operating control. The unit should be started or stopped by a temperature control actuated by the medium being cooled.

The Hi-Lo pressure cut-outs are preset at the factory for Refrigerant-12, and must be reset in the field if Refrigerant-22 is to be used.

The high pressure cut-out is factory set at 185 PSIG for refrigerant 12 and should be reset for refrigerant 22 with a maximum setting of 270 PSIG. This control incorporates a manual reset on both the high and low sides, which will prevent recycling if the machine goes off on either high or low pressure.

Only two adjustments are necessary, as shown in figure 6. The high pressure control is set by turning screw B and the low pressure cut out by turning screw A.

For complete instructions on the care and adjustment of the Safety High-Low pressure cut-out, see the manufacturer's instructions supplied with the unit.

REMOVING HIGH-LOW PRESSURE CUT-OUT:

Stop compressor.

Open condensing unit switch, and disconnect control circuit wires from control terminal posts. Tag wires and binding posts so they will be rewired properly.

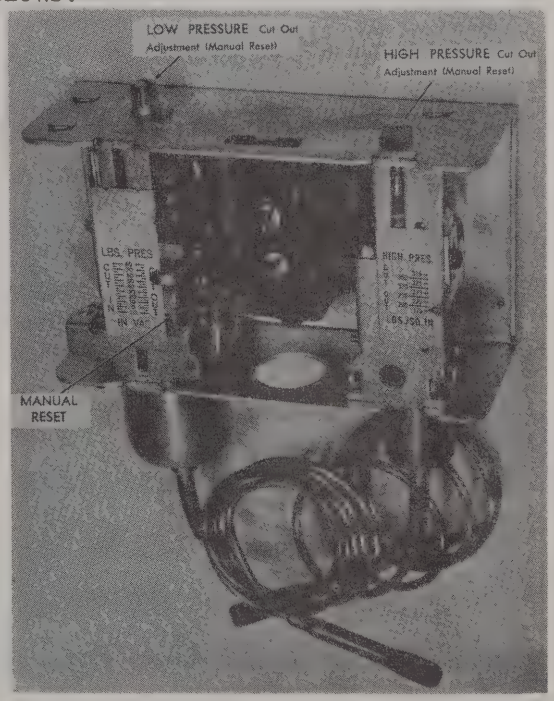
Close angle shut-off valves on compressor body for suction and discharge pressures, disconnect control tubing from control by loosening flare nuts and seal ends of tubing to prevent dirt from entering the line.

Remove High-Low Pressure cut-out from unit base.

REINSTALLING HIGH-LOW PRESSURE CUT-OUT:

Mount control on unit base.

Connect control tubing from suction side of compressor to the low pressure bellows, and the control tubing from discharge side of compressor to high pressure bellows.



Interior View of Dual Control.

Fig. 6

Connect control circuit to proper binding posts in control switch.

Crack angle shut-off valves to purge air and apply pressure to test for leaks.

OIL PRESSURE FAILURE SWITCH

The oil pressure failure switch, which is considered standard equipment on all but the 3HS2 and 3JS4 compressors, is a Penn type Oil Protection Control, providing in one unit, a differential pressure control plus an accurately compensated time delay switch. Since oil pressure is the combination of oil pump pressures and crankcase pressures, it is only necessary therefore to measure the difference (Differential) between the pump and the crankcase pressures to establish a control function.

OPERATION:

When compressor is started, a time delay switch is energized. If oil pressure does not build up to the predetermined setting of the control, the time delay trips, to stop the compressor. The compressor cannot be restarted again until the reset button on the control is manually reset. If oil pressures rise to or above the predetermined setting of the differential pressure control within the required time after the compressor starts, the time delay heater element is automatically deenergized, and the compressor continues to operate normally. If, however, oil pressure should drop below a safe minimum during the running cycle, the time delay heater is energized, and unless the oil pressure returns to normal within the time delay period, the compressor will be shut down.

The compressor can never run more than the predetermined time on subnormal OIL PRESSURE.

NOTE: Due to the operation of this switch, its function is to safeguard your compressor, so its wiring and settings should be carefully checked, and rechecked. NEVER set switch above or below WORTHINGTON'S recommended settings, and if compressor is SHUT OFF more than twice by this OIL PRESSURE FAILURE SWITCH, INVESTIGATE Compressor Oil Level, or other Refrigerant troubles, and as a good added safeguard, make a meter test of the heater and time delay circuit of the oil failure switch, making sure that it is not burned out.

NOTE: If the heater circuit is burned out, the manual reset side of this switch can be reset CLOSED, and the compressor can start, BUT YOU OPERATE WITHOUT OIL PRESSURE FAILURE PROTECTION FROM THE TIME THIS HEATER ELEMENT BURNS OUT. You will never know of this condition UNLESS YOU METER TEST THIS SWITCH AFTER ABNORMAL SHUT-DOWN BY THIS SWITCH. Possible bearing failure or loss of your compressor may result if this notice is neglected.

TIME DELAY:

The time delay device is a trip-free bimetal, manual reset type wired as an integral part of the differential pressure control. The timing is PENN factory set to 90 seconds, its maximum. This unit is completely compensated to assure uniform timing under all ambient temperatures. (Timing is affected by variations in voltages).

If its heater element is burned out from defective wiring, or abnormal running of the compressor, or compressor short cycling, etc., IT CAN NO LONGER PROTECT THE COMPRESSOR FOR OIL PRESSURE FAILURES.

TO INSTALL OIL PRESSURE FAILURE SWITCH:

1. Pump down compressor, to 1 or 2 lb. gauge.
2. Remove oil pressure gauge.
3. Insert nipple and tee. (When oil cooler is used.)
4. Oil pressure snubber fittings should be used on both the high and low pressure connections.
5. Connect high pressure line of control and oil pressure gauge to tee on high pressure connection of oil pump or on "oil leaving" connection of oil

cooler when oil cooler is used.

6. Connect low pressure line of control to gas equalizing opening using necessary tee and nipple. (See Fig. 7)

7. Leak test all connections.

8. The oil failure switch incorporates a direct reading, visible calibrated scale indicating the cut-in and cut-out points and should be set to protect the compressor as follows:

   If the oil pump delivery pressure is not known, install gauges on both the oil pump discharge and the compressor crankcase. With the system in operation and the compressor at running temperature, read pressures on both gauges. The gauge pressures indicates the oil pump pressure or "effective pressure'.

   Set the cut-in pointer 3 lb. below the effective oil pump pressure and the cut-out pointer 7 lb. below cut-in pointer. Adjustment is made by turning cam located under the upper control bellows, which sets cut-in point. Cut-out point is set by adjusting nut located on left side of control.

9. Connect wiring as indicated on PENN INSTRUCTIONS, included in control package.

NOTE: The recommended effective oil pressure is 25-40 lb. The setting of the oil pressure switch should be such that the compressor will not operate below 20 lb. oil pressure.

CRANKCASE HEATER:

A 250 watt crankcase heater is supplied as standard equipment on all but the 3JS4 compressors. The purpose of this heater is to boil off any liquid refrigerant that may accumulate in the crankcase. A thermostat controls the heater and should be set at 110°F, which will maintain the crankcase "warm to the hand". If the crankcase is hot

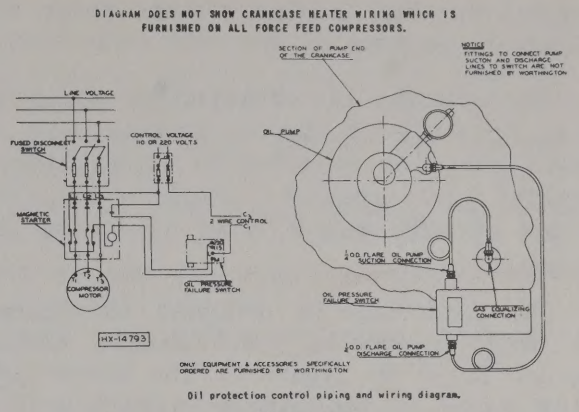


DIAGRAM DOES NOT SHOW CRANKCASE HEATER WIRING WHICH IS FURNISHED ON ALL FORCE FEED COMPRESSORS.
SECTION OF PUMP END OF THE CRANKCASE
NOTICE
FITTINGS TO CONNECT PUMP SUCTION AND DISCHARGE LINES TO SWITCH ARE NOT FURNISHED BY WORTHINGTON
LINE VOLTAGE
FUSED DISCONNECT SWITCH
CONTROL VOLTAGE 110 OR 220 VOLTS
OIL PUMP
MAGNETIC STARTER
2 WIRE CONTROL
OIL PRESSURE FAILURE SWITCH
COMPRESSOR MOTOR
1/4 OD FLARE OIL PUMP SUCTION CONNECTION
OIL PRESSURE FAILURE SWITCH
GAS EQUALIZING CONNECTION
HX-14793
1/4 OD FLARE OIL PUMP DISCHARGE CONNECTION
ONLY EQUIPMENT & ACCESSORIES SPECIFICALLY ORDERED ARE FURNISHED BY WORTHINGTON
Oil protection control piping and wiring diagram.

Fig. 7

to the touch, this indicates approximately 140° F which is too hot.

The heating elements should be submerged in the oil at all times to prevent the formation of carbon deposits.

NOTE: The crankcase heater should always be wired through a separate disconnect switch to provide current during the off cycle and for shut down periods of short duration (weekends etc.)

SHELL AND TUBE CONDENSERS

The Worthington model 200 condensing unit is supplied with a water colled condenser having removeable heads and replaceable tubes. On the smaller units (CDS-110, 111, 215, 217 and 219) the condenser is mounted under the compressor in the unit base. These condensers are supplied with a 180° F melting plug and has the water connections on the motor end.

On the larger units, the condenser is mounted above the compressor with the water connections at the compressor end. On condensers CDS-221 - 225 one pressure relief valve is supplied set to relieve at 235 PSI for R-12 and 300 PSI for R-22. Two relief valves in parallel are supplied on condensers CDS-226 - 230 set to relieve at 235 PSI for R-12 and 300 PSI for R-22.

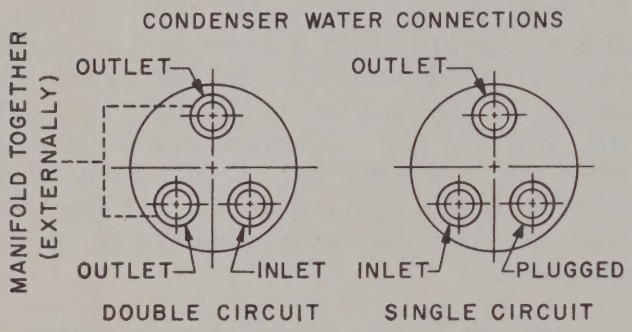
A pressure actuated water regulating valve is available on order and when supplied should be installed in the water inlet connection to the condenser. This valve is actuated by the discharge pressure of the condensing unit to control the flow of water, which maintains a desired operating head

pressure and also to shut off the water when the unit is stopped.

This valve is actuated by the discharge pressure of the condensing unit to control the flow of water which maintains a desired operating head pressure and also to shut off the water when the unit is stopped.

The condenser is designed to accommodate both a parallel and single circuit hook-up. Refer to Figure 8. The water regulating valve on the single circuit hood-up is connected to the condenser water inlet. See Fig. 8. On the parallel circuit hook-up, the water regulating valve is removed, if one is used, and the two smaller openings are manifolded together and become the condenser return outlets to the water tower. Remove pipe plug from larger opening and connect piping from water tower as this opening is the condenser inlet.

The condenser under the single circuit hook-up has 8 passes, and under the parallel circuit hook-up, has 4 passes.



PK-3695

Fig. 8 - Condenser Hook-Up

REMOVING CONDENSER:

Remove refrigerant from system and store it in clean empty refrigerant cylinders.

Close suction line valve, discharge line valve and liquid line valve.

Disconnect liquid line valve from adapter and plug hole in condenser to prevent dirt from entering.

Unsweat discharge line at condenser.

Disconnect water lines (both supply and drain) from condenser. Remove water regulating valve to avoid damage to valve while removing condenser.

Remove condenser support bolts.

REINSTALLING CONDENSER:

Remove all wooden plugs and blank flanges from the condenser openings.

Lift condenser and insert condenser support bolts. Line up discharge line with condenser and tighten up support bolts. Resweat discharge line at condenser.

Replace liquid line fittings and valve.

Install water regulating valve. Reset water valve if setting has been changed.

Connect water lines and fittings (both supply and drain) to condenser.

Evacuate and test system.

Charge system with small amount of vapor refrigerant and test for leaks.

Add balance of correct charge.

WATER REGULATING VALVE:

The purpose of the water regulating valve is to control the flow of water to the condenser, maintaining a predetermined head pressure on the unit, and shutting off the water when the unit is idle. Usually the contract will specify the water flow (G.P.M./ton) and will show the entering condensing water temperature for which the unit was selected. The operating conditions will determine the outlet water temperature and the operating head pressure. The water regulating valve should be adjusted to maintain the desired operating head pressure regardless of the entering water temperature, at the time of adjustment.

ADJUSTING WATER REGULATING VALVE:

For instructions to adjust the water regulating valve and the resulting operating head pressure of the unit, see the instruction card enclosed in the "Instruction Envelope" received with the unit.

REMOVING WATER REGULATING VALVE:

Pump down compressor to 1 lb. pressure.

Disconnect control line by turning off flare coupling nut. Plug end of control line, and cap pressure connection on water valve to prevent dirt getting into system.

Close the water supply shut off valve. Disconnect the water supply line by breaking union and remove nipple on inlet side.

Drain condenser and remove water valve from street elbow. For instructions to clean or repair water valve, see instruction card furnished with valve.

***NOTE:** This procedure necessary for underslung condensers (CDS-110, 111, 215, 217 and 219) only as the overhead mounted condensers are equipped with an angle shut off valve mounted on top of condenser. This valve can be closed and water regulating valve control tubing removed as described above.

REINSTALLING WATER REGULATING VALVE:

The valve should be installed on the water inlet connection making certain that water flow is in direction of arrow on valve body. A good grade of pipe compound should be used on water connections to eliminate leaks.

Connect refrigerant head pressure control line to capillary tube by flared coupling nut. Allow a small amount of gas to escape to purge air from control line of water valve. Tighten flare nut.

Open compressor discharge and suction valve, test control line and water regulating valve bellows with Halide torch for leaks.

Place unit back in operation.

NOTE: If a water tower set up is to be used, no water regulating valve will be used.

STOP VALVES:

The Model "J" units are equipped with suction and discharge line shut off valves of the backseat type. The valve has a packed valve stem and a seal cap to go over the stem to further prevent the possibility of leaks. The valve body has two 1/4 inch standard iron pipe threaded service connection openings, which can be used for gauge or control line connections. The backseat has no effect on the valve service connection at the end opposite the valve stem. This should not be opened unless the compressor is pumped down to one pound pressure and valves completely closed. The other 1/4" service connections on the stem end of valve body is to be opened only with valve backseated.

NOTE: Never open either one of service connections with the valve closed and a vacuum on the compressor as this will allow air and moisture to be drawn into the system.

OPERATION OF VALVES:

To open both the main refrigerant line and service connection to the compressor at the same time, remove the seal cap and open valve all the way counter clockwise, then turn clockwise 1/2 turn. When valve has been turned to desired position, the seal cap should be put on and kept on at all times.

SERVICE TROUBLES:

General service work is covered in the Service Manual, but service calls can be greatly reduced and customer satisfaction greatly increased by periodic inspection of the unit by an experienced refrigeration serman. Such an inspection should include:

1. Oiling and cleaning motor.
2. Checking fuses or overload protection.
3. Checking belt tension.
4. Checking compressor oil level and operating pressure.
5. Checking refrigerant operating temperatures.
6. Cleaning control contact points.

REPLACED PARTS:

Replaced parts should be carefully protected by the service man against damage and foreign matter until determined if they are to be returned to the factory or not. All replaced parts should be returned by the service man to his shop, for disposition by the foreman, or service manager.

MOUNTING INSTRUCTIONS

SHEAVES

MOUNTING:

1. Back out cap screws and remove QD hub from sheave. Be sure taper bore of sheave and cone surface of hub is free of dirt, grit and paint. Wiping these surfaces with a slightly oiled rag will insure uniform draw-up.

2. Loosen lockscrew in QD hub flange and slide QD hub on shaft, flange end first, and assemble key. "Do not tighten set screw over key until instruction No. 3 is completed."

3. Position QD hub on shaft then tighten lock screw in flange until QD hub is snug on shaft. Do not use excessive force on lock screw. Lock screw is intended to only hold QD hub on shaft against lateral movement while assembling rim on QD hub.

4. Tighten set screw in flange over key.

5. Place sheave in position on taper part of QD hub, align cap screw holes in rim with tapped holes in flange and assemble cap screws and lock washers.

6. Draw up tightly but evenly on cap screws. If sheave hub draws up to actual contact with QD hub flange, shaft is seriously undersize or bore in QD hub is seriously oversize. If this condition exists the QD hub should be replaced with one of proper bore size.

DISMOUNTING:

1. To dismount sheave remove cap screws and replace two of them in threaded holes in sheave rim hub to act as jack screws to start sheave off taper, after which sheave can be lifted from QD hub.

2. Loosen lock screw and set screw and slide QD hub from shaft. If QD hub is tight on shaft, it can be easily loosened by driving small wedge or screw driver in split part of flange.

CRANKCASE HEATER:

A crankcase heater is immersed in the crankcase oil, to hold the temperature of the oil high enough during shutdown to prevent freon condensing in crankcase. The heater includes a thermostat which should be set from 100°F to 120°F heater size is 250 watts.

The crankcase heater should be installed with a seperate fused switch so that the heater will be on when the main switch is off.

Leave these instructions with the unit for future reference.

C-1100-E47C 584 NBS
Supersedes C-1100-E47B

Litho'd in U.S.A.